CITY COUNCIL
CITY AND COUNTY OF HONOLULU
HONOLULU, HAWAII

No. 20-229

RESOLUTION

ACCEPTANCE OF THE ALA WAI CANAL FLOOD RISK MANAGEMENT PROJECT REPORT OF THE PERMITTED INTERACTION GROUP.

WHEREAS, on March 8, 2019, the City Council ("Council") adopted Resolution 19-50, establishing and authorizing a Permitted Interaction Group, composed of Councilmembers Ann Kobayashi, Carol Fukunaga, and Michael Formby, regarding the Ala Wai Canal Flood Risk Management Project ("Project"), which relates to the official business of the Council; and

WHEREAS, Resolution 19-50, in accordance with Section 92-2.5, Hawaii Revised Statutes ("HRS"), authorized the Permitted Interaction Group to:

1. Meet with State legislators and other federal, State, and County officials; and

2. Hold community meetings to receive input from community stakeholders and the public to investigate issues and concerns relating to the Ala Wai Canal Flood Risk Management Project; and

WHEREAS, on May 7, 2019, the Council adopted Resolution 19-108, which provided that the Permitted Interaction Group, established and authorized by Resolution 19-50, would continue to be composed of Councilmembers Ann Kobayashi and Carol Fukunaga, and substituted the then newly elected Councilmember Tommy Waters for interim Councilmember Michael Formby; and

WHEREAS, Resolution 19-108 further reiterated the Permitted Interaction Group's scope of authority stating in the BE IT FINALLY RESOLVED clause that:

> [T]he permitted interaction group shall present a written report to the Council summarizing the meetings held, input received, and community dialogue from the community meetings, at a Council meeting, pursuant to HRS Section 92-2.5(b)(1)(C), and, upon the Council's acceptance of the report at a subsequent Council meeting, the group shall be dissolved;

and

RESOLUTION

WHEREAS, in August 2019, the Council hired Oceanit Laboratories ("Oceanit") as engineering consultants to help address community concerns and technical issues, develop alternative engineering analyses and technical solutions in response to concerns raised by Ala Wai watershed stakeholders and other interested parties, and assist the Permitted Interaction Group in preparing its report to the Council; and

WHEREAS, on August 27, 2020, the Permitted Interaction Group presented its report to the Council in accordance with Resolution 19-50, as amended by Resolution 19-108, via Council Communication 245 (2020) ("CC-245 (2020)"), and requests the Council's acceptance of the report as presented; now, therefore,

BE IT RESOLVED by the Council of the City and County of Honolulu that having found that the report of the Permitted Interaction Group on the Ala Wai Canal Flood Risk Management Project complies with the Permitted Interaction Group's authorization under Resolution 19-50, as amended by Resolution 19-108, the report submitted via CC-245 (2020), is hereby accepted by the Council; and

CITY COUNCIL
CITY AND COUNTY OF HONOLULU
HONOLULU, HAWAII

No. 20-229

RESOLUTION

BE IT FINALLY RESOLVED that upon adoption of this resolution the Permitted Interaction Group shall be dissolved.

INTRODUCED BY:

Ann H. Kobayashi

DATE OF INTRODUCTION:

SEP 3 2020

Honolulu, Hawaii

Councilmembers

CITY COUNCIL

CITY AND COUNTY OF HONOLULU
530 SOUTH KING STREET, ROOM 202
HONOLULU, HAWAII 96813-3065
TELEPHONE: (808) 768-5010 • FAX: (808) 768-5011

August 27, 2020

Council Chair Ikaika Anderson
Members of the Honolulu City Council
530 S. King Street, Room 202
Honolulu, HI 96813

Dear Chair Anderson and Councilmembers,

Subject: **PERMITTED INTERACTION GROUP REPORT**
Resolutions 19-50 and 19-108, Establishing a Permitted Interaction Group to Investigate Matters Related to the Ala Wai Canal Flood Risk Management Project

Resolution 19-50, in accordance with Section 92-2.5, Hawaii Revised Statutes ("HRS"), established a PIG comprised of Councilmembers Ann Kobayashi, Carol Fukunaga, and Michael Formby and authorized the PIG to:

1. Meet with State legislators and other federal, State, and County officials; and
2. Hold community meetings to receive input from community stakeholders and the public to investigate issues and concerns relating to the Ala Wai Canal Flood Risk Management Project.

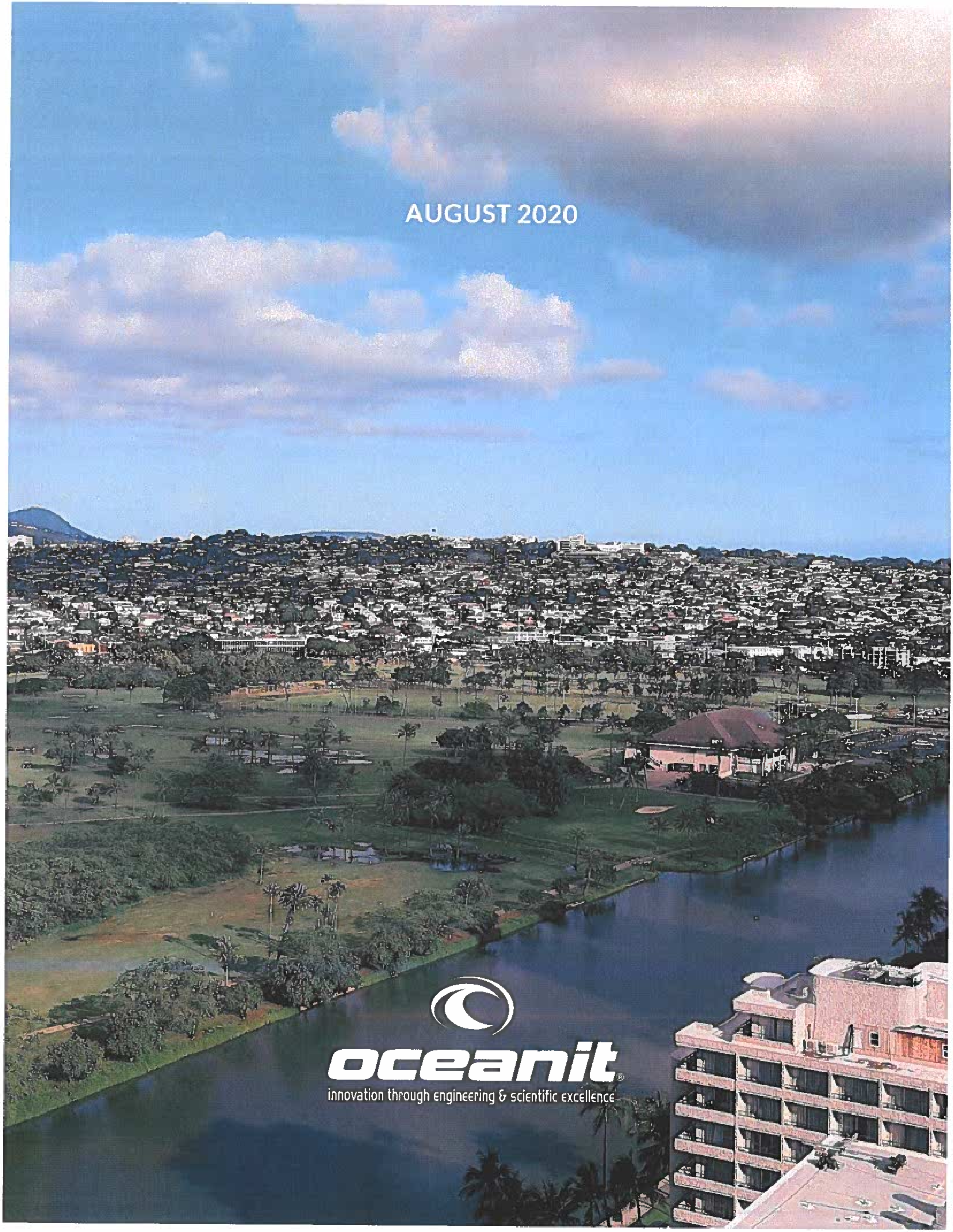
Resolution 19-108 amended the membership of the PIG with Councilmember Tommy Waters replacing Councilmember Formby, whose temporary appointment as a councilmember for Council District 4 ended with Councilmember Waters' election to the seat.

The members of your Permitted Interaction Group respectfully submit this report to the City Council, in accordance with Resolution 19-50, as amended by Resolution 19-108.

Mahalo,

ANN H. KOBAYASHI	CAROL FUKUNAGA	TOMMY WATERS
Councilmember, District 5	Councilmember, District 6	Councilmember, District 4

COUNCIL COM. 245


AUGUST 2020
oceanit
innovation through engineering & scientific excellence

REPORT OF THE PERMITTED INTERACTION GROUP

INVESTIGATING THE ALA WAI CANAL FLOOD MITIGATION PROJECT

Introduction

The Permitted Interaction Group ("PIG") established by ***Resolution 19-50,*** *Establishing A Permitted Interaction Group To Investigate Matters Related To The Ala Wai Canal Flood Risk Management Project*, which was adopted by the Council of the City and County of Honolulu ("Council") on March 8, 2019, and which was further amended by ***Resolution 19-108***, *Amending the Membership of the Permitted Interaction Group Established and Authorized to Investigate Matters Related to the Ala Wai Canal Flood Risk Management Project*, and adopted by the Council on May 5, 2019, respectfully submits this report.

Resolution 19-50, in accordance with Section 92-2.5, Hawaii Revised Statutes ("HRS"), established a PIG comprised of Councilmembers Ann Kobayashi, Carol Fukunaga, and Michael Formby and authorized the PIG to:

1. Meet with State legislators and other federal, State, and County officials; and
2. Hold community meetings to receive input from community stakeholders and the public to investigate issues and concerns relating to the Ala Wai Canal Flood Risk Management Project.

Resolution 19-108 amended the membership of the PIG with Councilmember Tommy Waters replacing Councilmember Formby, whose temporary appointment as a councilmember for Council District 4 ended with Councilmember Waters' election.

Background

The purpose of the Ala Wai Canal Flood Risk Management Project is to minimize flood risks in the Ala Wai Watershed. The watershed is approximately 19 square miles and extends from the Koolau Mountains to Mamala Bay. It consists of three sub-watersheds: the upper watershed is zoned as Conservation District to protect Oahu's aquifer, while the middle and lower watersheds are urbanized, supporting businesses, approximately 40 public and private schools, two universities, and around 55 parks. The Ala Wai Watershed reflects an ahapua'a orientation that follows the Manoa, Makiki and Palolo Streams as they drain into the Ala Wai Canal.

The Ala Wai Watershed also includes the Waikiki ahupua'a – which, as Hawaii's premier tourist destination, is the most densely-populated Oahu neighborhood with major residential, commercial, and institutional development. According to the U.S. Army Corps of Engineers ("USACE"), flash-flooding conditions can materialize within an hour at the upper portion of the Ala Wai Watershed and cause extensive property damage and risk human life. A major flood event, categorized as a one in 100-year event in this region would impact 1,358 acres, damaging 3,000 structures and costing more than $1.14 billion (2016 costs).

Now owned and maintained by the State of Hawaii and USACE, the Ala Wai Canal is a 2-mile-long artificial waterway constructed during the 1920s and designed primarily to drain coastal wetlands and allow for the development of Waikiki. It was also designed to handle stormwater run-off and to keep stream sediment and debris from reaching Waikiki beaches. As a result, bacteria, chemicals, viruses and other pollutants have degraded the water quality in the canal.

The State Department of Health regularly issues health warnings. Debris, trash, silt, and sediment have also built up throughout the years. In 2020, the State Department of Land and Natural Resources is undertaking the first major dredging project in roughly 18 years.

To reduce the flooding hazards and risks in the watershed, the USACE released its Draft Feasibility Study Report with an Integrated Environmental Impact Study in 2015. The USACE's tentative plan proposed the following flood mitigation measures, including construction of:

- In-stream detention basins in the upper reaches of Makiki, Manoa, and Palolo Streams;
- Standalone debris catchment feature in Manoa Stream;
- Multi-purpose detention basins in an open area in the urbanized portion of the watrshed;
- Floodwalls along the Ala Wai Canal (including associated pump stations); and
- In-stream improvements to restore passage for native aquatic species.

Chronology of Events associated with City Council PIG

In March 2019, following news reports that 37 private property owners might lose portions of their properties as a result of the Ala Wai project, the State Department of Land and Natural Resources and City Department of Design and Construction held a town meeting at Manoa Gym to present updates on the Ala Wai Canal Flood Risk Management Project and to answer questions about it. Hundreds of residents, students, public and private school representatives, community stakeholders and concerned citizens turned out for the meeting, and subsequently mobilized to voice their concerns about the project.

Members of the PIG also attended the meeting, and the Honolulu City Council adopted ***Resolution 19-145**, Urging the Mayor and the City Administration to address the Concerns of the Affected Communities regarding the Ala Wai Flood Risk Management Project and to Consider and Explore Alternative Plans that Minimize Impacts to Area Residents, Schools, and other Stakeholders* on July 3, 2019.

Between the months of February-November 2019, seven out of eight Neighborhood Boards within the Ala Wai Watershed adopted resolutions urging (a) the USACE to defer action on the flood control project until community stakeholders had an adequate opportunity to consider and weigh in on the project and potential alternatives; and (b) the State Legislature to defer appropriating funds for the project during the 2019 legislative session.

On August 19, 2019, PIG members Kobayashi, Fukunaga and Waters convened a community meeting at Neal Blaisdell Center's Maui Meeting Room to introduce Oceanit, the Council's engineering consultant, to community stakeholders and seek their recommendations within smaller discussion groups. The agenda and materials distributed at the meeting and a list of the meeting attendees are included in Appendix E of this report.

On September 19, 2019, the 'Protect our Ala Wai Watersheds' organization, which was comprised mainly of Manoa and Palolo residents, filed a lawsuit seeking injunctive relief to halt action on the flood control project.

The PIG convened an informational meeting on October 1, 2019 at Ala Wai Elementary School to update community stakeholders on Oceanit's discussions with various watershed constituencies. Copies of the meeting agenda, materials distributed at the meeting, and questions posed by attendees were posted as a link to ***Resolution 19-108***: http://www4.honolulu.gov/docushare/dsweb/Get/Document-237172/RES19-108.htm.

They are also included in Appendix F of this report.

On Oct. 29, 2019, Hawaii Circuit Court Judge Crabtree issued a preliminary injunction blocking the state from providing its $121 million contribution until the project delivered an environmental impact statement that complied with state law.

During November 2019-June 2020, the Oceanit engineering team has undertaken a broad range of engineering analyses and technical solutions on behalf of the City Council to address concerns raised by Ala Wai Watershed stakeholders and other interested parties.

For example, the Council's Committee on Public Infrastructure, Technology and Sustainability (PITS) held an Informational Briefing on the Ala Wai Canal Flood Mitigation Project by the Oceanit and its engineering team to illustrate revised modeling simulations that arose from small-group discussions about Oceanit's SWIFT tunnels technology. A video record of the June 17, 2020 PITS meeting is posted at http://www4.honolulu.gov/docushare/dsweb/Get/Document-265234/061720%20Committee%20on%20Public%20Infrastructure%2c%20Technology%20and%20Sustainability%20Written%20Summary%20for%20Video%20Record.pdf

The PIG also convened a virtual community meeting, which included question/answer discussions at Oceanit offices on July 30, 2020 entitled "Informational Status Update Briefing on the Ala Wai Canal Flood Mitigation Project." A video record of the meeting is located at https://www.oceanit.com/news/ala-wai-watershed-project-updates/; and is being uploaded with written questions posed to USACE as a link to the ***Resolution 19-108, CD1*** website: http://www4.honolulu.gov/docushare/dsweb/Get/Document-237172/RES19-108.htm

Study Methodology

At the outset, PIG members agreed on the importance of scientific, engineering and technical expertise to evaluate the USACE Ala Wai Canal Flood Risk Management Plan and provide recommendations on alternative solutions. The City Council therefore retained a consultant team with strengths in the following areas:

- Technical experience in ocean engineering and a broad spectrum of completed projects in Hawaii;
- Experience in integrating native Hawaiian culture and practices, and respect for unique community practices and sensitivity;
- Prior experience and expertise in developing community outreach and engagement solutions, with a focus on resiliency and sustainable solutions;
- Ability to develop consensus with diverse categories of stakeholders, including local, state, and federal government officials;

Findings and Recommendations

The August 2020 Ala Wai Watershed Flood Mitigation Project Report of the Permitted Interaction Group prepared by the Oceanit engineering team members provides most of the substance of the Honolulu City Council's PIG report. A detailed list of Oceanit's engineering analyses and PIG meetings is detailed in a list of appendices below:

1. Introductory Section from the City Council Permitted Interaction Group (August 27, 2020)
2. August 2020 Ala Wai Watershed Flood Mitigation Project Report of the Permitted Interaction Group – Oceanit (August 27, 2020)
3. Appendix A: Survey Results
4. Appendix B: Contribution of SWIFT to Flood Mitigation
5. Appendix C: Tunnel Cost Estimate and Conceptual Design
6. Appendix D: Summary of USACE EDR
7. Appendix E: August 19, 2019 PIG Meeting and Materials
8. Appendix F: October 1, 2019 PIG Meeting and Materials

On August 17, 2020, the USACE published an Engineering Documentation Report ("EDR") that identifies a modified plan for the Ala Wai Canal Flood Risk Management Project: https://www.poh.usace.army.mil/Missions/Civil-Works/Civil-Works-Projects/Ala-Wai-Flood-Risk-Management-Project/

A detailed summary of the revised EDR plan is found in as Appendix D; and PIG members anticipate a thorough analysis of its features, in combination with Oceanit's SWIFT proposal and other recommendations, will be undertaken in coming months.

To promote broad-based discussion of the Ala Wai Canal Flood Risk Management Project and begin identifying future financing requirements, the PIG is releasing its Report at a time that Ala Wai Watershed community leaders and stakeholders are reviewing the EDR plan.

Accordingly, your PIG finds that the following actions will provide the Honolulu City Council with the most comprehensive, practical flood risk management solutions for the Ala Wai Watershed:

1. Seek City initiation of an EIS process that evaluates the Oceanit 'SWIFT' engineering solutions in combination with the August 2020 USACE EDR plan;
2. Expedite the environmental review process for a joint City-State-USACE flood risk management partnership; and
3. Encourage state legislative and council collaboration in identifying state/county financing mechanisms that equitably distribute costs of the project among the three partners.

The members of your Permitted Interaction Group respectfully submit this report to the City Council, in accordance with ***Resolution 19-50***, as amended by ***Resolution 19-108***.

Councilmember Ann Kobayashi

Councilmember Carol Fukunaga

Councilmember Tommy Waters

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List of Figures

Acronyms & Abbreviations

% percent
ACE annual chance exceedance
AWWA Ala Wai Watershed Association
BCR benefit cost ratio
BLNR Board of Land and Natural Resources
CCH City and County of Honolulu
CFS cubic feet per second
CIP capital improvement programs
DAR (State of Hawai'i, Depart. of Land and Natural Resources) Division of Aquatic Resources
DBEDT (State of Hawai'i) Department of Business Economic Development and Tourism
DDC (City and County of Honolulu) Department of Design and Construction
DEIS Draft Environmental Impact Statement
DLNR (State of Hawai'i) Department of Land and Natural Resources
DOH (State of Hawai'i) Department of Health
DOT (State of Hawai'i) Department of Transportation
DPP (City and County of Honolulu) Department of Planning and Permitting
EA Environmental Assessment
EAB expected annual benefits
EAC expected annual cost
EDR Engineering Documentation Report
EIS Environmental Impact Statement
ELT (USACE) Executive Leadership Team
EPA U.S. Environmental Protection Agency
FCSA Feasibility Cost Sharing Agreement
FEIS Final Environmental Impact Statement
FEMA Federal Emergency Management Agency
FRM Flood Risk Management
GIS geographic information system
HAR Hawai'i Administrative Rules
HEC-FDA (USACE) Hydrologic Engineering Center-Flood Damage Reduction Analysis
HEC-HMS (USACE) Hydrologic Engineering Center Hydrologic Modeling System
HEC-RAS (USACE) Hydrologic Engineering Center River Analysis System
HEPA Hawai'i Environmental Policy Act
HRS Hawai'i Revised Statutes
LERRDs Lands, Easements, Rights-of-way, Relocations, and Dredge/Disposal
LDRIP Long-Term Disaster Recovery Investment Program
MOA Memorandum of Agreement
MS4s municipal separate storm sewer systems
MTBM microtunnel boring machine
N/A not applicable
NEPA National Environmental Policy Act
NFIP National Flood Insurance Program
NOAA National Oceanic and Atmospheric Administration
NOI Notice of Intent
NPDES National Pollutant Discharge Elimination System
NRCS (U.S. Department of Agriculture) Natural Resources Conservation Service

NWS National Weather Service
O&M operations and maintenance
OCCL (State of Hawai'i, Department of Land and Natural Resources) Office of Conservation and Coastal Lands
OEQC (State of Hawai'i, State Department of Health) Office of Environmental Quality Control
OMRR&R Operation, maintenance, repair, replacement, and rehabilitation
PCA (USACE) Project Cooperation Agreement
PED Preconstruction Engineering and Design
PIG (City and County of Honolulu) Permitted Interaction Group
PPA Project Partnership Agreement
ROD Record of Decision
ROM rough order of magnitude
SEB (USACE) Senior Executive Board
SEIS Supplemental Environmental Impact Statement
SHPD State Historic Preservation Division
SMA Special Management Area
SWIFT Subsurface Watershed Inundation Flow Technology
TBM tunnel boring machine
UH University of Hawai'i
USACE U.S. Army Corps of Engineers
U.S.C. United States Code
USFWS U.S. Fish and Wildlife Service
USGS U.S. Geological Survey
WRDA Water Resources Development Act
WSE Water Surface Elevation

Executive Summary

The Ala Wai Watershed is comprised of three narrow, steep valleys that feed into the Ala Wai Canal located in a highly urbanized area. Due to the watershed's natural geography as well as aging and undersized flood conveyance infrastructure, the Ala Wai Watershed is at high risk of flooding. The canal has overtopped several times over the last few decades, causing flooding in the Waikiki district. Additionally, in 2004, a storm led to heavy flooding in Manoa, which was estimated to have caused over $100 million in damages.

It has become increasingly apparent that the Ala Wai Watershed is unprepared for the events of a "low-probability, high-impact" event such as a 50- or 100-year flood. The effects of such a flood would be wide-reaching and devastating.

The Ala Wai Canal Project feasibility phase was initiated in July 2002. Following the 2004 Manoa flood, the Feasibility Cost Share Agreement (FCSA) was amended to include not only the lower canal, but also the upstream portions of the Ala Wai Watershed. In 2007, the project restarted, incorporating the information developed in the Manoa Watershed Project. However, in 2012, ecosystem restoration was eliminated as a study objective. The project was renamed from Ala Wai Canal Project to Ala Wai Canal Flood Risk Management. A report by the Chief of Engineers was signed in December 2017 and a Record of Decision for the EIS was signed by the ASA (CW) in September 2018, concluding the feasibility phase of the Ala Wai Canal Flood Risk Management Project.

After the release of the 2017 FEIS, there was widespread community opposition. The community opposition was very consistent with the concerns raised in 2004. While this plan might prevent large-scale flood damage, community members felt it was deeply flawed, and would cause more damage—to the ecosystem and to property—than it was worth.

In March 2019, the Honolulu City Council established a Permitted Interaction Group (PIG) to investigate matters relating to the Ala Wai project, and retained Oceanit as a technical consultant. Oceanit held several community meetings involving residents, private businessowners, non-profit leaders, and government officials to collect feedback and input from those who would be affected most directly. Residents believe that there are better, more community-friendly alternatives that don't condemn private land and flood schools and provide equal or increased flood protection than those presented in the USACE plan. Community members brought forward other ideas to solve the problems such as flood gates and locks in the Ala Wai, flood pumps in the Ala Wai, underground detention basins, retractable canal walls, dryland and wetland plots to dissipate and hold flood waters and dredging of the Ala Wai to improve water flow.

Concurrently, USACE updated its modeling system from HEC-RAS-1D to HEC-RAS-2D, significantly enhancing the system's capabilities. The new system also indicated a significant increase in the amount of water that will flow from the upper watersheds to the lower watersheds, leaving an abundance of water in the McCully-Mo'ili'ili areas as well as overtopping the Ala Wai Canal. Oceanit was able to validate this using the modeling software and data shared by USACE. Dealing with the accumulated water in the lower watershed was of high priority for all stakeholders, and USACE asked Oceanit to investigate and recommend ways to resolve it. After presenting these findings with the PIG and discussion with USACE, Oceanit's scope of work concentrated on a conceptual design to mitigate lower watershed flooding, leaving other flood mitigation features to USACE.

Oceanit's recommendation is called SWIFT: Subsurface Watershed Inundation Flow Technology and utilizes tunnels to remove water from the upper watersheds, bypass the lower watershed and the Ala Wai Canal, and discharge directly into the ocean. SWIFT can be integrated with the USACE's updated EDR recommendations and addresses many of the community's most pressing concerns.

In developing SWIFT, the following community-focused goals were kept in mind to reach or exceed all objectives:

- Remove enough water from a 50-100-year flood event to match that of a 20-25-year flood event, the current design capacity
- Improve safety
- Minimize environmental impact
- Increase recreational access and utilization
- Maintain federal funding commitment
- Eliminate or minimize the need for flood walls
- Minimize the use of detention basins
- Eliminate the need to condemn private property

In preparing the conceptual design of SWIFT, Oceanit analyzed various configurations including the number of tunnels, the diameter of the tunnels, the potential locations of tunnels entrances, benefits of each approach and costs. The current configuration of two 12-foot tunnels, one for Manoa and one for Palolo, provides optimal performance.

In modeling the conceptual design of SWIFT, Oceanit determined that the tunnels will remove a significant amount of water from the upper watershed during 50- and 100-year events directly to the ocean, minimizing the effects of flooding in the lower watersheds and preventing overtopping of the Ala Wai Canal. This will complement the USACE designs documented in the EDR.

It is recommended that the City expedite an environmental review of a combined flood mitigation of SWIFT with USACE's EDR features. The integration of the SWIFT tunnels concept, along with elements of the USACE updated EDR recommendations, provides the best path to address an optimal solution while addressing the concerns of the communities involved.

History of the Ala Wai and Oceanit's Involvement

History of the Ala Wai Canal

The Ala Wai Canal was constructed in the 1920s in order to dry out the marshlands in the lower watershed and allow the development of what is now the Waikiki district. Three streams originating from Makiki, Manoa, and Palolo valleys were merged into a single, 2-mile-long waterway. The canal was designed to handle stormwater run-off and to keep stream sediment and debris from reaching Waikiki beaches. As a result, bacteria, chemicals, viruses, and other pollutants have degraded the water quality in the canal.

The Ala Wai Canal, now owned and maintained by the State of Hawai'i and USACE, is the sole water outlet for the 19-square-mile watershed and capable of providing flood protection against the effects of a 20- to 25-year rainfall event. The watershed consists of three sub-watersheds: the upper watershed is zoned as Conservation District to protect Oahu's aquifer, while the middle and lower watersheds are urbanized, supporting businesses, approximately 40 public and private schools, two universities, and around 55 parks.

Need for Flood Mitigation

The Ala Wai Watershed is comprised of three narrow, steep valleys that feed into the Ala Wai Canal located in a highly urbanized area. Due to the watershed's natural geography as well as aging and undersized flood conveyance infrastructure, the Ala Wai Watershed is at high risk of flooding. The canal has overtopped several times over the last few decades, causing flooding in the Waikiki district. Additionally, in 2004, a storm led to heavy flooding in Manoa, which was estimated to have caused over $100 million in damages.

It has become increasingly apparent that the Ala Wai Watershed is unprepared for the events of a "low-probability, high-impact" event such as a 50- or 100-year flood. The effects of such a flood would be wide-reaching and devastating. Flooding associated with a 100-year rainfall event would affect approximately 1,358 acres within the Ala Wai Watershed, including over 3,000 properties with an estimated $1.14 billion in structural damages not accounting for loss in business income or other similar economic losses. The affected population includes approximately 54,000 residents plus an additional estimated 79,000 visitors in Waikiki on any given day.

USACE Prior Studies

The Ala Wai Canal Project reconnaissance phase was completed in September 1999, indicating Federal interest in assisting the State of Hawai'i in the restoration of the Ala Wai Canal and authorizing the project to continue into the feasibility phase. The reconnaissance phase request was initiated by the State of Hawai'i Department of Land and Natural Resources (DLNR) in April 1999, who sought a comprehensive management and restoration plan to restore aquatic habitat and biological diversity in the Ala Wai Canal and upstream tributaries.

Separately, an Ala Wai Flood Study was completed in 2001, documenting a high flood hazard associated with potential overtopping of the Ala Wai Canal. The study was initiated by request of the DLNR Land Division in September 1998, to determine the potential flood risk to the Waikiki area. The results of this technical study established federal interest in investigating flood risk management in the canal. As a result, a flood risk management objective was added to the Ala Wai Canal project, expanding the project to focus both on ecosystem restoration and flood risk management in the canal area.

The Manoa Watershed Project was initiated in 2006 by the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), following a 2004 flood that resulted in millions of dollars in damages to Manoa, which also encompasses the University of Hawaii. The project provided detailed topographic mapping, hydrologic and hydraulic modeling, and identification of potential measures to address specific flood problems within Manoa Valley. The findings were summarized in the 2008 Manoa Technical Report. However, due to limited funding the project was terminated before any measures could be implemented.

The Ala Wai Canal Project feasibility phase was initiated in July 2002, following USACE approval for continuation from the reconnaissance phase. A Feasibility Cost-Share Agreement (FCSA) was executed between USACE and the DLNR in 2001 to address both ecosystem restoration and flood risk management along the Ala Wai Canal. Following the 2004 Manoa flood the FCSA was amended to include not only the lower canal, but also the upstream portions of the Ala Wai Watershed. In 2007, the project restarted, incorporating the information developed in the Manoa Watershed Project. However, in 2012, ecosystem restoration was eliminated as a study objective. It was determined that the biological resources within the watershed had regional significance but were not of sufficient national significance to adequately justify ecosystem restoration as an objective. The project was renamed from Ala Wai Canal Project to Ala Wai Canal Flood Risk Management Project prior to the release of the final Feasibility with Integrated Environmental Impact Statement (FEIS) in 2017. A report by the Chief of Engineers was signed in December 2017 and a Record of Decision for the EIS was signed by the ASA (CW) in September 2018, concluding the feasibility phase of the Ala Wai Canal Flood Risk Management Project.

Previous Work Done by Oceanit

Oceanit has been involved with water resources engineering for over 35 years and has worked extensively within the Ala Wai Watershed. Through numerous flood studies and watershed and ecosystem reports, Oceanit has developed a thorough understanding of both the unique challenges this complex water system poses as well as the concerns of residents and community stakeholders.

Oceanit's work within the Ala Wai Watershed includes:

Ala Wai Canal Project, July 2003

The State of Hawai'i through the Department of Land and Natural Resources (DLNR) as the non-federal sponsor and the USACE contracted Townscape, Inc. and Oceanit to prepare a comprehensive management and restoration plan to restore aquatic habitat and biological diversity in the Ala Wai Canal and upstream tributaries. A final report was issued in July 2003.

Ala Wai and Manoa Watersheds Ecosystem and Flood Mitigation, 2007

Oceanit was retained to conduct stream assessments of the Ala Wai Watershed to identify problems and recommend stream ecosystem restoration methods. Oceanit used HEC-RAS to perform a hydrologic analysis of the Ala Wai Watershed to estimate peak flow discharges and flow depths for various storm events. This project was executed cooperatively with the Ala Wai Watershed Project and the Manoa Watershed Project.

Manoa Watershed Project, Nov. 2008

The Natural Resources Conservation Service, US Department of Agriculture (NRCS), contracted Oceanit through the USACE to prepare a feasibility report and Environmental Impact Statement (EIS) to prevent the recurrence of flooding similar to what occurred in October 2004 in the Manoa Watershed.

Oceanit prepared the following technical reports:

- Existing environment (Townscape 2008)
- Hydrologic analysis of existing conditions (Oceanit 2008)
- Hydraulic analysis of existing conditions (Oceanit 2008)
- Conceptual flood reduction measures designs for the Manoa Watershed

Oceanit issued its final Technical Summary Report for the Manoa Watershed Project in November 2008 that summarized the elements of these studies designed to reduce potential flooding in the Manoa Watershed. The studies conducted for the Manoa Watershed Project were to be used for the USACE study of the Ala Wai Watershed Project that would look at the entire Ala Wai Watershed that includes the valleys of Makiki, Manoa, Palolo, and the lower watershed of Ala Wai and Waikiki. However, due to limited funding the project was terminated before any measures could be implemented.

Ala Wai Watershed Project, Dec. 2008

The USACE contracted Oceanit to develop a Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS) for a range of potential storms in the Ala Wai Watershed. HEC-HMS is the USACE hydrologic model. The purpose of this study was to estimate peak flow discharges at particular drainage junctions in the Ala Wai Watershed corresponding to the following storm return periods: 2, 5, 10, 20, 50, 100, 200, and 500-year. Oceanit issued its Final Hydrology Report in December 2008. The data from this study was to be used for the USACE study of the Ala Wai Watershed Project for the entire Ala Wai Watershed, which includes the valleys of Makiki, Manoa, Palolo, and the lower watershed of Ala Wai and Waikiki

Federal Monies Allocated to Provide Flood Mitigation

Ala Wai Canal Project, 2004

The Ala Wai Canal Project was investigated under Section 209 of the Flood Control Act of 1962 (Public Law 87-874). Funding for the Ala Wai Watershed project was authorized by Congress through the Water Resources Development Act.

The Ala Wai Canal Project feasibility phase was initiated in July 2002. A Feasibility Cost-Share Agreement (FCSA) was executed between USACE and the State of Hawai'i as represented by the Department of Land and Natural Resources (DLNR) in January 2001 with objectives to address both ecosystem restoration and flood risk management along the Ala Wai Canal. Following the 2004 Manoa flood, the FCSA was amended to include not only the lower canal, but also the upstream portions of the Ala Wai Watershed. An amendment was executed in November 2012, for a total estimated cost of $10.1 million, including work-in-kind of $2.385 million.

The City and County of Honolulu, Environmental Services (ENV), through a Memorandum of Agreement (MOA) with DLNR has contributed funds to address water quality issues within the study area. NRCS has agreed to be a cooperating agency on the feasibility study and EIS by providing technical assistance for this study.

Manoa Watershed Project, Nov. 2008

Congress appropriated $1 million for NRCS to pursue mitigation of stream flooding after the October 2004 flood. An additional $250,000 to $350,000 was needed to complete the feasibility report and Environmental Impact Statement (EIS), but due to other priorities at the federal level, these funds were not made available.

After consulting with the Congressional delegation, it became evident that the supplemental funds were unlikely to be obtained to complete the project. Consequently, the Manoa Watershed Project planning team revised the project deliverables from a combined feasibility report and EIS to several technical reports that would document the work completed to date in a format that could readily be incorporated into the U.S. Army Corps of Engineer's Ala Wai Watershed project (previously known as the Ala Wai Canal Project).

2017 Ala Wai Flood Risk Management Project

The Ala Wai Canal Project was renamed the Ala Wai Canal Flood Risk Management Project prior to the release of the final Feasibility Study with Integrated Environmental Impact Statement (FEIS) release in 2017. A report by the Chief of Engineers was signed in December 2017 and a Record of Decision for the EIS was signed by the ASA (CW) in September 2018, concluding the feasibility phase of the Ala Wai Canal Flood Risk Management Project.

Shortly following a Record of Decision in September 2018, the Ala Wai Flood Risk Management Project was funded for construction with Emergency Supplemental funds under the Bi-Partisan Budget Act of 2018 under the Long-term Disaster Recovery Investment Program (LDRIP) with an authorized cost of $345,076,000. The program allows for a single-phase design and construction as opposed to a more traditional design phase and subsequent construction phase to expedite funding and execution of projects. In addition, a deferred payment option for the NFS allows for expedited funding and project execution.

In accordance with the cost share provisions in Section 103(a) of the Water Resources Development Act (WRDA) of 1986, as amended (33 U.S.C. 2213(a)), the non-Federal sponsor is responsible for providing a minimum 5 percent cash contribution, all Lands, Easements, Rights-of-way, Relocations, and Dredge/Disposal (LERRDs) required for the project, and any additional funds necessary to make its total contribution equal to at least 35 percent of total project costs. In addition, the non-Federal sponsor is responsible for 100 percent of the operation, maintenance, repair, replacement, and rehabilitation (OMRR&R). For the 2017 Feasibility Study, the fully funded project cost with escalation to the estimated midpoint of construction, was estimated to be $352,204,000. This estimate was used in Project Partnership Agreements (PPA) and will continue to be refined through the detailed design phase. For the 2017 Feasibility Study, the non-Federal sponsor's amount was $123.3 million.

USACE Feasibility Study

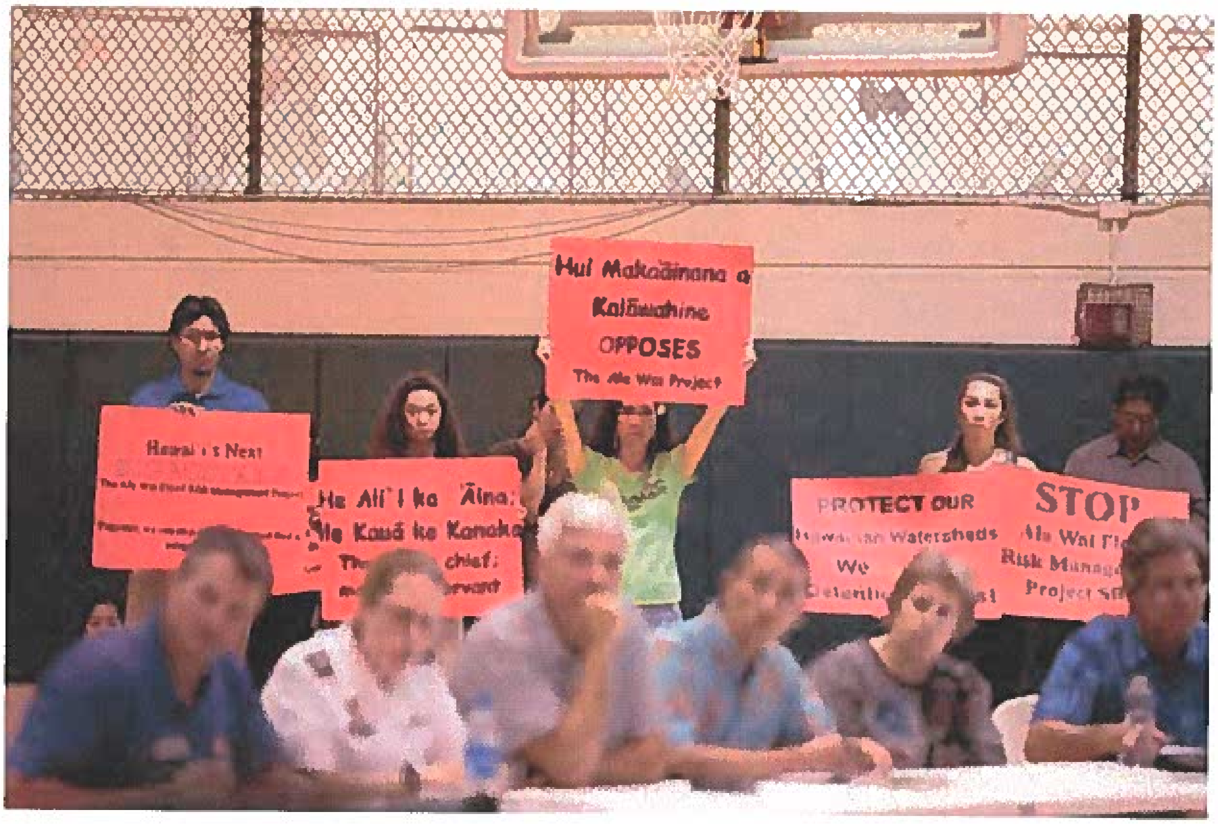
In 2017, after years of investigations, analysis, and modeling, the United States Army Corps of Engineers (USACE) proposed a flood mitigation scheme that included water detention and debris retention basins in Makiki, Manoa, and Palolo, sub watersheds, flood walls in the lower Ala Wai Watershed and pumping to manage flood waters. The Feasibility Study consisted of eleven structural and two-nonstructural features feeding into the Ala Wai Canal. Each feature was designed as a component of a system intended to (1) detain short duration, high intensity rainfalls in detention basins, and (2) increase storage capacity of the Ala Wai Canal to better contain flood waters thereby substantially reducing risk of life and property loss.

The proposed detention basins were meant to slow down storm discharges to reduce flood intensity downstream including Waikiki. The purpose of the debris retention basins were to eliminate large debris from blocking stream restrictions such as bridges downstream that could force the water to jump the banks and flow through public, residential and business areas, resulting in severe damage and potential loss of life. The USACE estimated the total project cost for their recommended Feasibility Study plan at $352.2 million (October 2016 price level). This breaks down to $228.9 million at 65% for the federal cost and $123.2 million at 35% for the non-federal cost.

Community Opposition

The plan met with fierce opposition from homeowners whose properties would be affected by the detention basins, as well as from Hawaiian activists and environmental groups. Residents in the watershed's upper reaches voiced strong concerns about how the USACE plan might impact their neighborhoods and natural streams. Many believed the Army Corps' plan was flawed and outdated, based on 20th-century ideas about flood protection, and lacking the type of adaptive capacity that more natural solutions offer.

Hawaii News Now, 3/20/2019



Star Advertiser, 8/22/2019

Technical critiques also arose as community members argued that the plan did not follow NEPA and HEPA (HRS §343) regulations and that it was based on inaccurate or outdated data. Importantly, the community was upset that there was no communication and no transparency in the creation of the proposed plan.

Community members advocated for plans that would include additional benefits such as ecosystem restoration, introduction of green infrastructure, water quality improvement, stream maintenance, stormwater repurposing, and recovery of the Waikiki ahupua'a.

Several suggestions were put forward including:

- Flood Gates/Locks in the Ala Wai
- Flood Pumps in the Ala Wai
- Underground Detention Basins
- Retractable Canal Walls
- Create dryland and wetland plots to help dissipate energy and hold floodwaters
- Dredge Ala Wai Canal to improve water flow in the canal

The boards of seven out of eight Honolulu neighborhoods affected by the plan passed resolutions requesting a temporary halt to the project. Waikiki Neighborhood Board No. 9 did not participate as it viewed itself as the most at risk of flooding. The seven boards that passed the resolution include:

1. Kaimuki Neighborhood Board No. 4

2. Diamond Head-Kapahulu Neighborhood Board No. 5
3. Palolo Neighborhood Board No. 6
4. Manoa Neighborhood Board No. 7
5. McCully-Mo'ili'ili Neighborhood Board No. 8
6. Makiki-Tantalus Neighborhood Board No. 10
7. Ala Moana-Kaka'ako Neighborhood Board No. 11

Their resolutions urged (a) the USACE to defer action on the flood control project until community stakeholders had an adequate opportunity to consider and weigh in on the project and potential alternatives; and (b) the State Legislature to defer appropriating funds for the project during the 2019 legislative session.

On September 19, 2019, the group Protect Our Ala Wai Watersheds sued the State and City & County and requested a temporary injunction. It argued the city and state rushed the environmental impact statement (EIS) process and that residents did not have the opportunity to fully comment on it.

On October 29, 2019, Hawai'i Circuit Court Judge Crabtree issued a preliminary injunction blocking the State from providing its $121 million contribution until the project delivers an EIS that complies with state law. On October 31, 2019, Honolulu Mayor Kirk Caldwell sent Governor Ige a letter with concerns regarding the flood control project's compliance with state environmental law. The city would not accept the project's existing federal EIS because it did not follow several key requirements under state law.

City Council Response to Community Reaction

On March 8, 2019, the city council adopted Resolution 19-50, which established the Ala Wai Permitted Interaction Group (PIG) with three members of the Honolulu City Council.

In August 2019, Oceanit was hired as consultants for PIG consultant to the City Council to address community concerns and technical issues.

On August 19, 2019, PIG Councilmembers Kobayashi, Fukunaga, and Waters convened a community meeting at Neal Blaisdell Center's Maui Meeting Room to introduce Oceanit, the Council's engineering consultant, to community stakeholders and seek their recommendations within smaller discussion groups. The agenda and materials distributed at the meeting and a list of the meeting attendees are included in Appendix E of this report.

In December 2019, the PIG requested USACE add Oceanit to its project governance structure as the PIG representative. USACE uses a three-tier governance structure to manage the project and ensure effective communication.

1. Tier 1 is the USACE Senior Executive Board (SEB) made up of USACE senior headquarters staff, the City & County Mayor and the PIG, and a representative from the State of Hawai'i/Governor's Office. The SEB meets quarterly.
2. Tier 2 is the Executive Leadership Team (ELT) made up of USACE District staff and selected department Directors from the City & County. The ELT meets monthly.
3. Tier 3 is the Project Leadership Team (PLT) made up of USACE technical leads and project managers, and the City and County of Honolulu project technical leads.

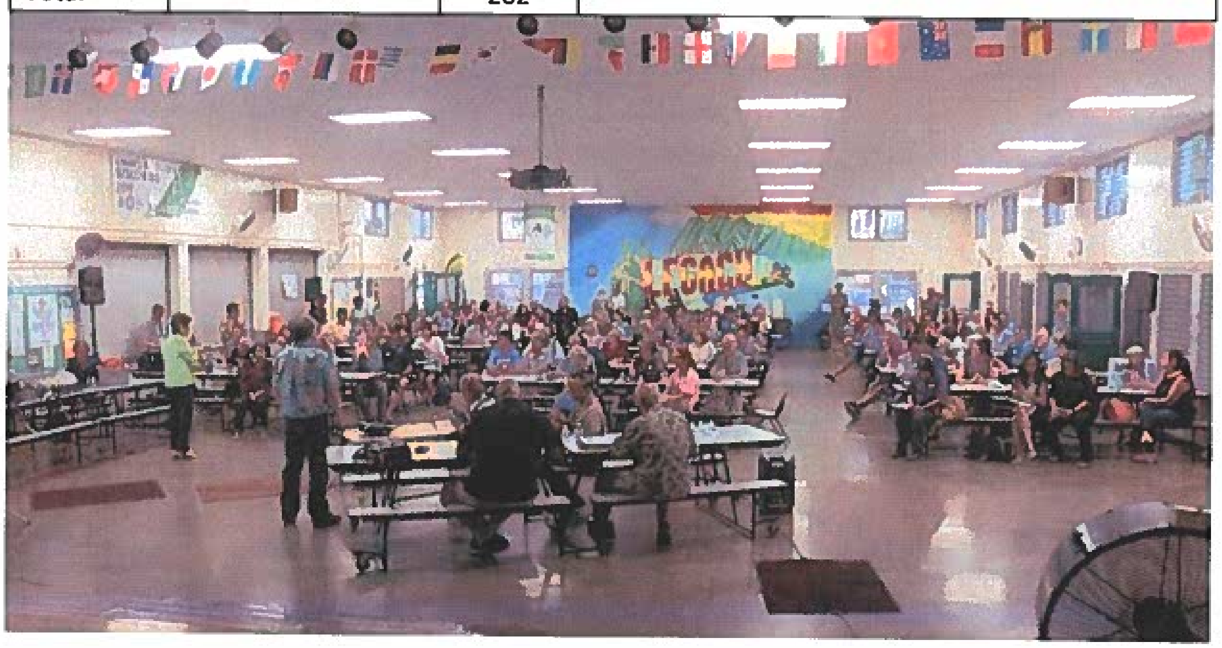
Oceanit began to attend these meetings on December 31, 2019 and has attended 10 of these meetings to date.

Community Outreach

Between August and November 2019, acting on behalf of the PIG, Oceanit conducted numerous smaller focused community outreach meetings rather than watershed-wide meetings to field thoughts and opinions on the USACE plan as outlined in the 2017 Feasibility Study. Among those contacted to participate were private individuals, private landowners and businesses, community leaders, community organizations, city and state agencies, and elected officials.

The following table lists the community meetings held between August and November 2019.

Date	Group	# of people	Content
8/19/2019	Community	60	Introduced PIG; announced hiring Oceanit
8/29/2019	Lower Watershed	12	Meeting to gather issues and alternatives
9/3/2019	1st upper watershed	14	Meeting to gather issues and alternatives
9/4/2019	2nd upper watershed	14	Meeting to gather issues and alternatives
9/5/2019	Palolo & Orgs	13	Meeting to gather issues and alternatives
9/10/2019	Schools & Orgs	14	Meeting to gather issues and alternatives
10/1/2019	Community	75	Update on Oceanit work, results, next steps
Total		202	



Star Advertiser, 10/01/2019

Several community concerns quickly came to the forefront. Perhaps the largest of which was a tremendous distrust of USACE and its messages to the community. Under this umbrella of distrust, community members expressed several concerns:

- The community was concerned with the USACE's assumptions, models and data resulting in erroneous outcomes.
- The community believed the USACE plan was flawed and that it would do more harm if implemented and needed to be redone. The community wanted adaptive solutions not technical explanations.
- The community did not believe federal funding was at risk and believed it was a ploy to push USACE's original plan.
- There was a lack of transparency, trust, empathy, and stakeholder/community involvement.
- The project's National Environmental Protection Act (NEPA) review document was already outdated and did not reflect the actual project. Others were concerned the State EIS was not final and was based on the USACE NEPA.
- The USACE plan would flood Mo'ili'ili to protect Waikiki. The community strongly voiced that they did not want to put the upper watershed at risk to protect Waikiki. The community voiced that they want a more inclusive plan.
- The habitat and ecosystem restoration initiatives were removed from the scope of the USACE project. The community wanted them restored to the project.
- The concrete walls along the Ala Wai Canal are unsightly and create a problem in moving 400 lb. canoes in and out of the water. The walls would cripple their access to the water.

The community concerns listed above are very consistent with the concerns raised by the community previously. Prior to the Manoa flood in October 2004, Ala Wai Watershed community members were primarily concerned about improving the overall quality of the water in the watershed and implementing ecosystem and habitat restoration ideas. Following the flood, there were more concerns about flooding, the ability of the bridges to handle stormwater, the use of floodwalls, the lack of stream maintenance resulting in the clogging and overflow of streams, the use of hard structures, and non-native trees in the upper watershed. The community wanted to see the implementation of alternatives that would help with both flood mitigation and habitat restoration, including the use of parks for stormwater detention and the creation of wetland plots to help dissipate energy and hold floodwaters.

Aside from infrastructure concerns, community members also believed that there are better, more community-friendly alternatives that did not condemn private land and flood schools and provide equal or increased flood protection than those presented in the USACE plan. They also recommended a paradigm shift—for example, USACE wants to keep water out by holding or storing the water, but citizens want a way to remove the water quickly from floods, storm surge, and high tides to minimize flooding. Community members also recognized that alternative plans may not be fundable by the USACE project and suggested considering the use of public and private funds for the project.

Apart from the USACE plan, community members advocated for plans that would include additional benefits such as ecosystem restoration, introduction of green infrastructure, water quality improvement, stream maintenance, stormwater repurposing, and recovery of the Waikiki ahupua'a.

Several suggestions were put forward including:

- Flood Gates/Locks in the Ala Wai
- Flood Pumps in the Ala Wai
- Underground Detention Basins

- Retractable Canal Walls
- Create dryland and wetland plots to help dissipate energy and hold floodwaters
- Dredge Ala Wai Canal to improve water flow

Through this process, it became apparent that four things were necessary in a community-approved solution: no detention basins, no floodwalls, no condemnation of private property, and if possible, ecosystem restoration.

Community Suggested Alternatives

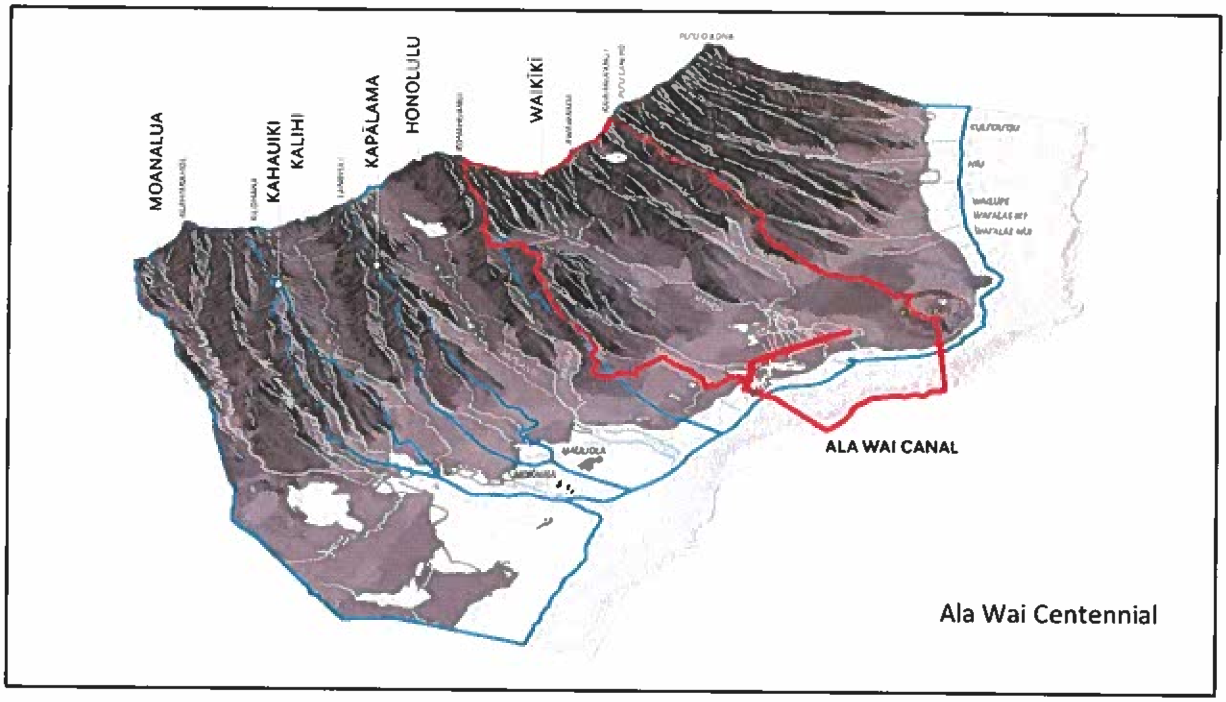
As Oceanit began to identify alternatives to USACE's plan, several suggestions were proposed by community members. It should be noted that these suggestions have been examined and ruled out by USACE as beyond the scope of the project.

A solution proposed by community member and retired civil engineer Dave Watase involved using a moveable storm surge barrier (flood gate and high capacity flood pump) that can be engaged to protect Waikiki and the surrounding areas from flooding and sea level water rise. This plan calls for the installation of a surge gate and submersible pump at the Ala Wai Boulevard Bridge that would mechanically lower and control the water level. Additionally, closing the flood gates ahead of a storm could allow pumps to remove water from the canal, creating additional storage capacity. Once the flood gate was closed, the Ala Wai Canal can potentially be protected from tide surges up to the height of the Ala Moana Bridge (estimate +8-ft storm surge protection).

Flood pumps could run variably during the duration of the storm to maintain adequate safety detention storage for overflows and with the ability to protect from even bigger flood events beyond the 100-year flood. A flood gate and flood pump method would also be able to protect from sea level rise and storm surge. A flood gate could be permanently closed should sea level rise become a reality and protect our existing gravity flow storm water drainage system.

Community member and pump engineer with Hawaii Engineering Services Inc. Mike Elhoff suggested a five-step solution focused on water retention and pumping. The five steps included: focusing the retention basin at the Ala Wai Golf Course; dredging the Ala Wai canal to its original 25-foot depth; significantly reducing erosion, silt, and debris in the Ala Wai basin; continuous water quality pumping; and instantaneous stormwater pumping to draw down the canal based on advanced signal from rain gage sensors in the upper watershed. Included in reducing debris in the Ala Wai, this solution also proposed eradicating feral pigs and erecting pig fencing from the edges of the watershed to the ridgeline.

Sean Connelly, community member and CEO of Ala Wai Centennial, suggested using urbanization to recover the ahupua'a using an "ecological revolution" approach, defined as the process of regaining possession of land, water, and other resources that have been lost, providing a framework toward achieving a culture of climate resilience. Applied to the Ala Wai watershed, this approach would include tactics like removing impervious surfaces to increase absorption capacities, retrofitting stream channels, and implementing civic flood parks. For the canal specifically, Connelly suggested installing a pump and lock system and tidal controls where the canal meets the sea in order to control the water level. Tidal controls include the construction of a dam equipped with active and passive pump systems coupled with upland stream sensors, emergency overflow release mechanisms, canoe locks, fish passes/ladders, and stream-wide sediment/debris catchments.



An idea was also put forth by co-founders of the Hawaii Exemplary State Foundation, Dr. Kenneth Kaneshiro, a professor at the University of Hawaii and the Director with the Center for Conservation Research & Training, and General Darryl Wong, former Adjutant General for the State of Hawaii Department of Defense. They proposed a flood mitigation effort centered around a holistic, ecosystem-first approach. This plan would focus on restoring natural floodplains to serve as sponges during floods, reconnecting streams to their natural floodplains rather than building more levees, and cleaning the water in the Ala Wai Canal. The areas restored for better absorption during times of flooding could be used as recreation space or returned to its natural state.

Other suggestions from the community included ideas such as creating dryland and wetland plots surrounded by earthen berms to help dissipate energy and hold floodwaters so that they can be absorbed to replenish the groundwater; installing a second outlet in the canal to the ocean; implementing green infrastructure practices that enhance infiltration; and implementing underground water storage.

USACE Updates Its Models

From late 2018 through early 2020, USACE updated its Hydrologic Engineering Center's River Analysis System (HEC-RAS) 1D hydrologic and hydraulic modeling used in preparing its 2017 Feasibility Study to a more comprehensive HEC-RAS 1D/2D models to advance the project design. With improved simulation capabilities, the new model integrates the timing of storm flows, 2-dimensional analysis, more refined terrain elevations, and comprehensive precipitation data to more accurately approximate multi-directional overland flow patterns. Input for precipitation was estimated based on the NOAA Atlas 14 data from 1967, 1988, and 2004 storm events using average rainfall across the entire basin. The models are set for a 100-year flood at 95% confidence levels.

Upon updating the modeling system, USACE reported the flow data for the Ala Wai watershed is two to four times the amount of water from the 2004 flood. USACE said the original models underestimated the water flow in several key areas:

- Insufficient Detention – The capacity volume and retention time in the detention basins were insufficient to achieve the benefits modeled in the Feasibility Study.
- In-Stream Impediments – Improved simulation of in-channel constraints showed that water would be forced out of the banks at multiple bridge crossings.
- More Accurate Boundary Conditions – More accurate topographic data facilitated more representative boundary conditions, which broadened the extent of inundation in the lower watershed.
- Increased Out-of-Bank Routing – Better quality terrain data identified areas of lower elevations where, rather than going into storage, flow overtopped the channel banks and increased localized pooling and inundation.
- Higher Flow Rates – The new model predicts higher flows and volumes in the Ala Wai Canal, resulting in an increase in water surface elevation of approximately 2 feet.

In short, the new data showed that a 100-year storm event would lead to more extensive inundation across the base of the watershed and that the anticipated water surface elevation reductions from the 2017 Feasibility Study were not realized due to insufficient detention capacity and flow constraints along the routing. USACE Honolulu obtained approval from the USACE Vertical Team to investigate modifications to system features necessary for the system to perform as anticipated and document their recommendations in an Engineering Documentation Report (EDR). USACE announced it was developing new technical solutions to address model changes and achieve the Congressionally authorized level of flood risk reduction. One of the proposed changes included the removal of six detention basins from the upper watershed. However, this would lead to an increase in the flow of stormwater in the middle and lower watershed.

USACE reported the increased volume of water coming from the Manoa Valley would converge at Manoa Marketplace and would increase the flood risk from UH Manoa through McCully/Mo'ili'ili. USACE requested Oceanit assistance to find solutions. USACE also announced it would start meeting with several focus groups to share work being done and solicit feedback.

Oceanit and USACE agreed to work together to solve the problem. Oceanit requested HEC-RAS model information from USACE to evaluate their models, data, and assumptions.

Oceanit Begins Designing

In mid-February, USACE provided Oceanit with the initial HEC-RAS hydraulic model for two of the interim plans for flood control. These two plans explored the feasibility of using the Woodlawn bypass culvert to direct water flow to the Ala Wai Golf Course, preventing flooding of the University of Hawaii. Oceanit was told by USACE's hydraulic engineers that the features (e.g. golf course berm, pump stations) in these plans were still being refined and that the hydrology reports were based on the basin-averaged rainfall, which was outdated. Therefore, none of the features in these plans represented any finalized USACE flood control plans. However, the models were helpful in allowing Oceanit's engineers to become familiar with the model configuration and run trial simulations.

Later, upon request, USACE provided Oceanit the HEC-RAS models without flood mitigation features for all frequencies (2-year, 5-year, 10-year, 25-year, 50-year, 100-year, 200-year, and 500-year) in mid-March 2020. Using the HEC-RAS models without features, Oceanit reviewed the models to better understand the scope of the problem. Oceanit talked to USACE about the changes being considered and identified the target goals for the amount of extra stormwater that needed to be removed. Oceanit began to consider alternative solutions that could address the problem.

The PIG asked Oceanit to prepare new solutions to address USACE's higher flow rates, and Oceanit began investigating ideas to remove excess water in early January 2020. Oceanit started by employing Design Thinking techniques, approaching the problem from a human-centered viewpoint and taking into account what community members had to say. This involved focusing on a solution that addressed the entire ahupua'a—upper, middle, and lower watershed—and not just Waikiki.

As a result of discussions held with stakeholders and issues and concerns raised, Oceanit prepared a questionnaire and conducted a community survey to gauge the community's feelings on flood mitigation, the USACE plan, and the EIS. See Appendix A for the details of this survey.

Oceanit was then able to begin developing a pragmatic plan that would also take community needs into account. Ala Wai Watershed residents were concerned about flooding in the lower watershed. With the new models indicating increased flow from the upper watershed, they were even more concerned. The community wanted the excess water to be removed quickly to minimize flooding rather than being stored.

There were also a few agreed upon requirements for the solution:

1. It needed to improve safety from a low probability, high impact rain event
2. It needed to mitigate the risk of flooding in Waikiki and overtopping of the Ala Wai Canal
3. It needed to preserve the shared federal funds of $220 million to support the costs of the estimated $345 million project.

The biggest challenge with the updated USACE model is the sheer amount of water generated in the upper watershed, especially in Manoa. In discussions between Oceanit and USACE, it quickly became apparent that if the amount of water from the upper watershed could be significantly reduced, many of the features of the updated USACE plan would work to mitigate flooding in the lower watershed and prevent overtopping the canal.

With these things in mind, Oceanit developed the SWIFT (Subsurface Watershed Inundation Flow Technology) design concept that would utilize tunnels to remove water from the upper watersheds, bypass the lower watershed and the Ala Wai Canal, and discharge directly into the ocean. This concept was presented to PIG on February 24, 2020.

SWIFT

The main benefit of SWIFT is to provide an integrated approach to the Ala Wai ahupua'a. By reducing the amount of water flowing from the upper watersheds to the lower, more of the mitigation features USACE is working on can be directed to reducing the amount of water that would accumulate in the lower watershed and in Waikiki. Oceanit believes this is a holistic approach that benefits all communities.

The agreed upon goals for SWIFT are:

- Remove enough water from a 50-100-year flood event to match that of a 20-25-year flood event, the current design capacity of the Ala Wai canal
- Improve safety
- Minimize environmental impact
- Increase recreational access and utilization
- Maintain federal funding commitment
- Eliminate or minimize the need for flood walls
- Minimize the use of detention basins
- Eliminate the need to condemn private property

Oceanit met with the PIG and Ala Wai Watershed community members to review the goals and expectations for the conceptual design to get feedback and approval for the concept. Based on the feedback received, Oceanit built a prototype by modelling the proposed solution in HEC-RAS.

The watershed topography and the flood water discharge from hydrological models were evaluated to initially select tunnel intake locations. The factors considered in determining the tunnel intake locations were as follows:

- Water head available (difference in elevation between the start and end locations of the tunnel), which governs the discharge capacity of the tunnel (i.e., the larger the elevation difference/head, the higher the discharge pressure)
- Length of the tunnel, which relates to discharge rate as well as cost of construction (i.e., the longer the tunnel, the lower discharge rate and the higher the construction cost)
- Diameter of the tunnel to evaluate discharge capacity and construction cost (i.e., the larger the diameter, the higher the discharge capacity and the higher the construction cost)
- Amount of water available at the tunnel entrance during different rainstorm events (i.e., the higher the intake elevations above the ground, the lower the amount of stormwater available, longer the tunnel, lower capacity and higher construction cost)

Several tunnel inlets and outfalls were selected initially in the upper and middle areas of the three sub watersheds and the nearshore area. Hydraulic calculations were conducted using each of these locations to determine the discharge capacity for a 6-foot diameter tunnel. This indicated the optimum intake location for each of the tunnel intake locations. The ocean discharge was located at the 40 feet depth contour. The calculations were extended to tunnel diameters up to 12 feet in 2-foot increments.

The water intake points for the tunnels were selected to optimize the tunnel discharge by considering the elevation of the intake point, the tunnel length, and the tunnel diameter. The following tunnel intake locations were selected:

- Makiki Tunnel starts above Wilder Avenue, close to Anapuni Street, and ends in shallow ocean at a 40-foot depth
- Manoa Tunnel starts next to the Noelani Elementary School in Manoa and ends in shallow ocean at a 40-foot depth
- Palolo Tunnel starts at the crossing of Palolo Stream and Palolo Avenue and ends in shallow ocean at a 40-foot depth

These intake locations were selected for the purpose of simulating the water flows in the computer models used. A detailed engineering study along with a regulatory review is required to permanently define these points.

Using this information and different size diameter tunnels, Oceanit was able to calculate the amount of discharge in cubic feet per second.

The water intake from the streams will be through a specially designed structure called a weir located next to the stream and running parallel to it. The weir is built to a predetermined height (e.g. 25-year flood elevation), and when water overflows it, the weir is designed to "siphon" water into the tunnel intake structure. Otherwise, when the stream is flowing at normal levels, the weir allows the water in the stream to flow unobstructed. This design will not take any water from the stream during low flow stages and functions only when a significant flood condition occurs. The weir is designed to discharge full tunnel capacity flow during flood stages.

Oceanit integrated the tunnel concept into the 100-year event HEC-RAS model without flood mitigation features. With the tunnels, the HEC-RAS modeling results showed an elimination of flooding at the University of Hawai'i and a notable reduction of inundation in the lower watershed area. For example, flow depth in the McCully-Mo'ili'ili area was reduced by 0.5 feet on average, and up to 1 foot on the east side of Kalakaua Ave. However, due to the inherently large amount of rainfall from a 100-year storm event, the inundation levels in the lower watershed would still be significant, even with the tunnels.

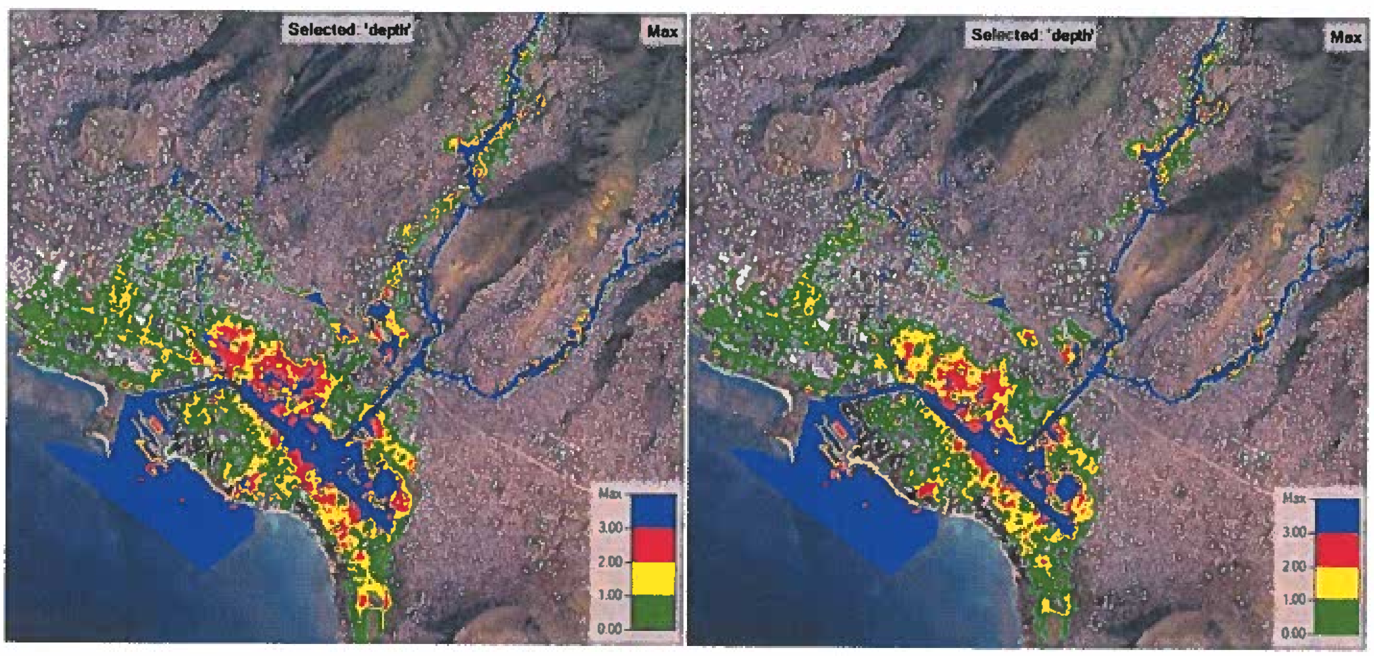


Figure 1 Flow depth comparison of without features (left) versus with three 10-foot diameter tunnels at Makiki, Manoa, and Palolo (right)

USACE suggested Oceanit also explore different locations for tunnel entrances including moving the Makiki tunnel entrance further downstream near the intersection of Kalakaua Avenue and Waiola Street and moving the Palolo tunnel entrance downstream of St. Louis Drive. Oceanit tested those modifications, and results showed that relocation did not help reduce flooding. Recognizing that the tunnel entrances need to be above a certain elevation to provide sufficient water head to drive the water in the tunnels to the ocean, Oceanit decided to keep the tunnel entrances at locations originally identified.

To optimize the SWIFT design, Oceanit performed a series of sensitivity studies using the HEC-RAS models. Oceanit found that the results from the Makiki tunnel were not significant enough to justify the construction costs of the tunnel. After eliminating the Makiki tunnel, Oceanit evaluated the remaining two tunnels with different tunnel diameters as well as the use of a single 14-foot Manoa tunnel.

See Appendices B and C for more details on the analysis and engineering work done to arrive at the SWIFT conceptual design.

The comparison of the modeling results showed that the two-tunnel option achieved the best performance in mitigating flooding in the lower watershed. In the two-tunnel case, flow depth is reduced by 1 foot in both the McCully-Mo'ili'ili and Waikiki areas as compared with USACE's model without features.

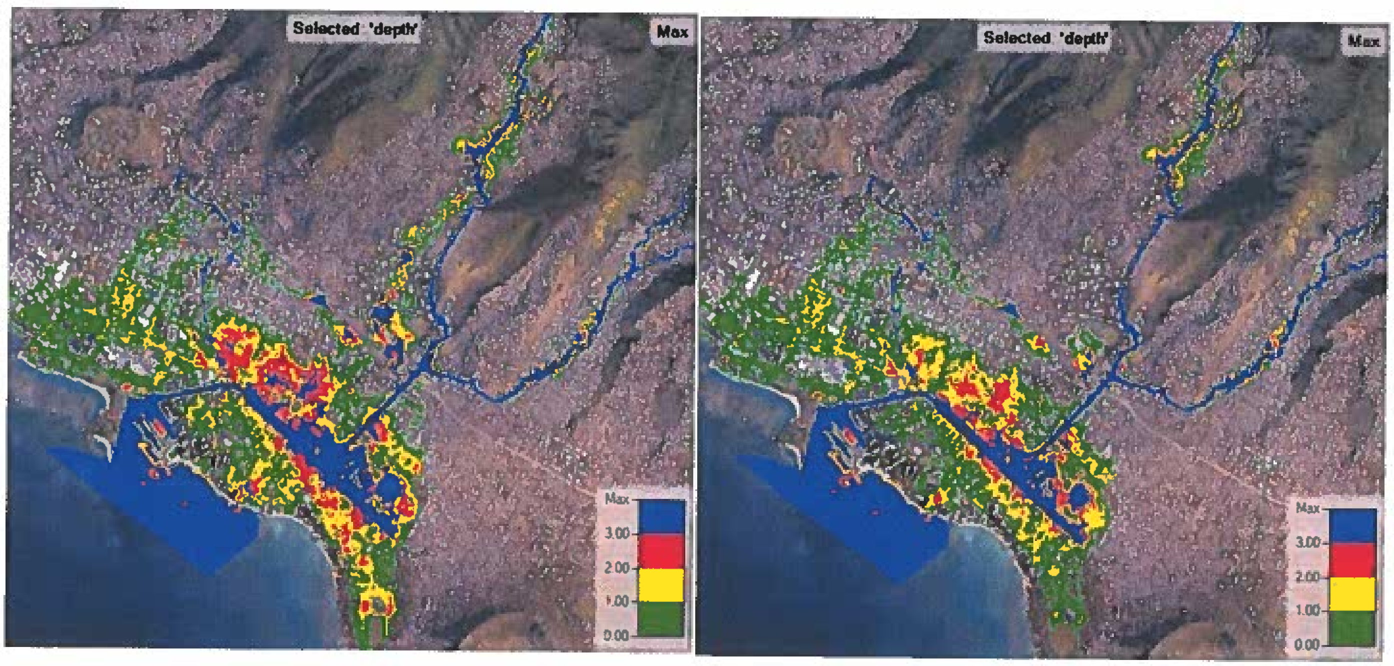


Figure 2 Flow depth comparison of without features (left) versus with 12-foot tunnel at Manoa and 10-foot tunnel at Palolo (right)

Oceanit searched for a company with tunnel design and drilling experience to move the project to the design and costing stage. The company subcontracted for this task was Brierley Associates (BA), a drilling company from Texas, currently involved in drilling a tunnel in Honolulu for the Environmental Services Department of the City and County of Honolulu. Their prior services and experience in Hawai'i include the construction of the Kaneohe–Kailua Wastewater Conveyance and Treatment Facilities Project.

BA reviewed and analyzed the requirements of the project. They prepared a conceptual design and preliminary cost estimate for two 12-foot diameter Manoa and Palolo tunnels. Their design consisted of a single 12-foot diameter tunnel for each watershed that ended at the lower watershed in a horizontal manifold with the axis parallel to the shoreline. This portion of the tunnel will be constructed by a tunnel boring machine drilling a 14-foot diameter hole and lining the hole with a 12-foot diameter concrete pipe. This machine is not able to drill into the ocean because of extraction complexities, so three 7-foot diameter tunnels will start from the manifold and end at 40-foot water depth. These will be constructed using micro-tunneling techniques.

The picture below shows the flow depth comparison of the without features flood map (left) compared to with flood map with the 12ft tunnel at Manoa and 12 ft tunnel at Palolo (right).

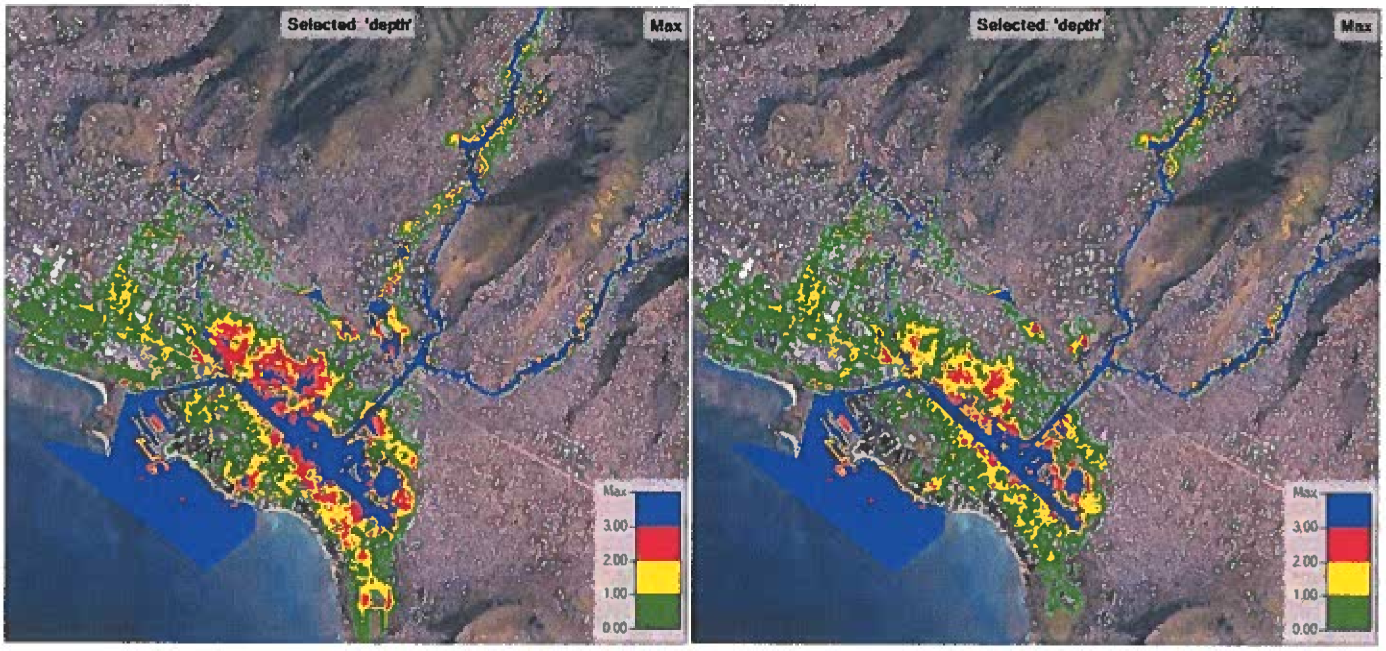


Figure 3 Flow depth comparison of without features (left) versus with 12-foot tunnel at Manoa and 12-foot tunnel at Palolo (right)

The 12-foot Manoa tunnel will have a flow rate of 2,955 cfs and the 12-foot Palolo tunnel will have a flow rate of 2,908 cfs for a combined flow rate of 5,863 cfs. This makes a significant impact in moving water directly to the ocean thereby reducing the water surface elevation of flooding in the lower watershed.

The SWIFT tunnels will remove a significant amount of water from the upper watershed during 50- and 100-year events directly to the ocean, minimizing the effects of flooding in the lower watersheds and preventing overtopping of the Ala Wai Canal. However, due to the inherently large amount of rainfall from a 100-year storm event falling in the watershed below the tunnel entrances, the inundation levels in the lower watershed would still be significant, even with the tunnels. Although SWIFT addresses stormwater in the upper watershed, a solution is still required for the lower watershed. Thus, SWIFT will complement the USACE designs documented in the EDR, which target flood mitigation in the lower watershed. Through the use of SWIFT and the new features developed by USACE, we believe this will provide the best benefits for the City & County of Honolulu.

Additional Benefits of SWIFT

The use of the tunnel manifold system will allow additional 7-foot diameter tunnels to be connected to facilitate pumping flood water from the Ala Wai Canal during peak flows, helping to reduce water surface elevations in the lower watershed.

These additional tunnels could not only augment the USACE modified recommendations but could also be used during non-storm events to pump fresh seawater into the canal to facilitate flushing and cleaning up the canal. This will improve water circulation, clean the canal, and get rid of invasive freshwater species that predate on native species.

Community Consensus

Oceanit met with the PIG and Ala Wai Watershed stakeholders to present the updated SWIFT concept, goals, and expectations; and review the model and cost estimates in order to get feedback and concurrence for the design. Seven meetings were held with 121 people to get feedback and concurrence for the design.

Oceanit also presented the SWIFT concept to USACE. USACE agreed with the concept and thought it would be very beneficial but objected to the economics. USACE said it could not fit the cost of SWIFT into its economic model. They went on to say if SWIFT were to be implemented, additional Non-Federal funding would need to be secured.

Based on the feedback received, Oceanit built a prototype by modelling the proposed solution in HEC-RAS. Oceanit created a physical 3D model of the watershed to better engage the community and communicate options and solutions. Flood inundation animations and flood maps could be projected onto the 3D model to demonstrate the effects of stormwaters at varying storm frequencies. A modified visualization tool was also created to allow for 2D presentations via zoom.

USACE Engineering Documentation Report

The proposed changes included the removal of six detention basins from the upper watershed; the addition of limited flood walls at two locations, upstream of the Woodlawn Bridge and the reach between Date Street and the Ala Wai Canal; the addition of two bypass diversion culverts around the Woodlawn Drive Bridge stream reach and at the base of the Makiki Channel into the Ala Wai Canal; and the consolidation of two pump stations into a single larger one.

On August 17, 2020, USACE released its Engineering Documentation Report (EDR) documenting changes to its authorized system of features in its 2017 Feasibility Study Report. The EDR was meant to document technical analysis completed following Congressional authorization of the project for construction, identify system modifications and the technical basis for those recommendations, and provide the engineering and data foundation for a future Validation Study. The system modifications evaluated included increasing the storage capacity by raising the top of the detention basins and floodwall heights, expanding the storage capacity of the detention basins through excavation, re-siting the structures to more suitable locations, and increasing detention times by optimizing discharge rates from the basins using flow control methods. The EDR is not a decision document. A Validation Report with supporting National Environmental Policy Act (NEPA) Documentation will serve as the updated decision document.

In summary, the EDR recommends:

- The removal of detention basins in the upper watershed, as well as detention basins at Woodlawn Ditch and a standalone debris catch structure in Manoa Stream;

- The addition of a Woodlawn bypass structure and ancillary measures to reduce flood risk at the Manoa Marketplace, University of Hawai'i at Manoa, and the lower watershed communities;
- The addition of a Makiki Stream bypass culvert to reduce risk of backwater flooding from the Ala Wai Canal, as well as reducing flood risk in the lower watershed of the Makiki community; and
- Modifications to authorized features at Kanewai, Hausten Ditch, Ala Wai Golf Course, and Ala Wai Canal flood barriers with pump stations.

In the EDR, USACE conducted rough-order-of-magnitude cost estimates and a preliminary economic analysis to gauge project trajectory based on early concepts in development and arrived at $376 million for the recommended modifications.

USACE indicated their engineers would consider SWIFT as a value-added engineering project.

As part of the Validation Study in the next phase, the conceptual recommendations presented in the EDR will be advanced in design to conduct the appropriate level of supplemental environmental analysis.

See Appendix D for a more detailed summary of the USACE Engineering Documentation report.

Upcoming USACE Activities

With the release of their EDR, USACE is now doing further analyses to begin the Validation Study. USACE plans to submit a public notice for a Supplemental NEPA in October 2020 and to begin scoping meetings for the NEPA, also in October 2020. SWIFT was not considered in the EDR and USACE said it could consider it as a value-added engineering study.

Conclusion

SWIFT is a design that was created from the input obtained from the various watershed communities during the community outreach sessions held in late 2019 and early 2020. The primary objective is to bypass the lower watershed and Ala Wai Canal areas, directing the water directly into the ocean. During this time USACE continued to work on enhancing the features of flood mitigation without having to resort to detention basins in Manoa and Palolo.

In modeling the conceptual design of SWIFT, Oceanit determined it will remove a significant amount of water from the upper watershed during 50- and 100-year events directly to the ocean, minimizing the effects of flooding in the lower watersheds and preventing overtopping of the Ala Wai Canal. This will complement the USACE designs documented in the EDR.

Through the use of SWIFT and the new features developed by USACE, Oceanit believes this will provide the best benefits for the City & County of Honolulu. Both SWIFT and the new features identified in the EDR will need to go through detailed design, ironing out many of the details. By incorporating SWIFT with the HEC-RAS models of the new features defined by the recent USACE EDR, the best combination of features can be determined to provide the most efficient and cost-effective solution. In addition, other community based solutions such as 1) Mr. Watase's proposal of moveable storm surge barriers that can protect Waikiki and surrounding areas from flooding due to a large storm as well as sea level rises, 2) Mr. Connelly's "ecological revolution" to recover the ahupua'a, 3) Mr. Elhoff's five-step solution focused on water retention and pumping, and 4) Dr. Kenneth Kaneshiro's and General Darryl Wong's flood mitigation efforts based on holistic, ecosystem-first approach using education, and others can be further evaluated for possible inclusion with the overall plan. Based on this approach, the basis for a detailed integrated design can then be planned.

It is recommended that the City expedite an environmental review of a combined flood mitigation of SWIFT with USACE's EDR features. The integration the SWIFT tunnels concept along with elements of the USACE updated EDR recommendations provides the best path to address an optimal solution while addressing the concerns of the communities involved.

Appendices

Appendix A – Survey Results

Appendix B – Contribution of SWIFT to Flood Mitigation

Appendix C – Tunnel Cost Estimate and Conceptual Design

Appendix D – Summary of USACE EDR

Appendix E – August 19, 2019 Community Meeting Documents

Appendix F – October 1, 2019 Community Meeting Documents

Appendix A: Survey Results

Summary

As a result of discussions held with stakeholders and issues and concerns raised, Oceanit prepared a questionnaire and conducted a community survey to gauge the community's feelings on flood mitigation, the USACE plan, and the EIS. This survey was sent to 93 people on Friday, February 7, 2020.

The survey asked respondents to rate 18 statements on a scale of strongly agree (5), agree (4), partly agree (3), disagree (2), strongly disagree (1). An average score of 3 indicates partial agreement with the statement. Half of the questions have an average response between 3.2 and 3.0; a very tight grouping where people partially agree. The other half of the questions have an average response below 3.0. These responses range between 2.9 and 1.6.

The survey results concluded that almost all the respondents agreed that flood mitigation measures are required and that there are better ways to minimize flooding than the USACE plan. Most believed the USACE plans were inadequate to protect the lower watershed areas.

		Total score	Average Score
1	I believe flood mitigation is required to protect my neighborhood	52	**2.1**
2	I believe flood mitigation is required to protect other neighborhoods	47	**1.9**
3	I believe flood mitigation is required to protect Waikiki	65	**2.6**
4	I was informed of the Corps Feasibility Study for the Ala Wai Watershed	61	**2.4**
5	I had an opportunity to comment on the Corps Feasibility Study for the Ala Wai Watershed	61	**2.4**
6	I believe others had an opportunity to comment on the Corps Feasibility Study for the Ala Wai Watershed	74	**3.0**
7	I trust what the Corps tells the community	74	**3.0**
8	I believe the Corps models and data accurately reflect the flood risk	80	**3.2**
9	I believe the Corps EIS accurately reflects the project environmental impacts	75	**3.0**
10	I believe the State EIS accurately reflects the project environmental impacts	71	**2.8**
11	I believe the Corps plans for the Ala Wai Watershed Flood Mitigation Project will protect Palolo	78	**3.1**
12	I believe the Corps plans for the Ala Wai Watershed Flood Mitigation Project will protect Makiki	80	**3.2**
13	I believe the Corps plans for the Ala Wai Watershed Flood Mitigation Project will protect Manoa	77	**3.1**
14	I believe the Corps plans for the Ala Wai Watershed Flood Mitigation Project will protect the lower Ala Wai Watershed	79	**3.2**
15	I believe there are better alternatives/possibilities to protect the Ala Wai Watershed	40	**1.6**
16	I believe the Corps will modify its plan for flood mitigation for the Ala Wai Watershed to incorporate your ideas	74	**3.0**
17	I believe the Corps will modify its plan for flood mitigation for the Ala Wai Watershed to incorporate the community's ideas	73	**2.9**
18	I believe the Corps statement that the Federal funds are at risk	62	**2.5**

Question #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Date & Time Stamp	1. I believe flood mitigation is required to protect my neighbor-hood	2. I believe flood mitigation is required to protect other neighborhoods	3. I was informed of the Corps Feasibility Study for the Ala Wai Watershed	4. I had an oppor-tunity to comment on the Corps Feasibility Study for the Ala Wai Watershed	5. I believe others had an oppor-tunity to comment on the Corps Feasibility Study for the Ala Wai Watershed	6. I trust what the Corps tells the community	7. I believe the Corps models and data accurately reflect the flood risk	8. I believe the Corps EIS accurately reflects the project environ-mental impacts	9. I believe the State EIS accurately reflects the project environ-mental impacts	10. I believe the Corps plans for the Ala Wai Watershed Flood Mitigation Project will protect Waikiki	11. I believe the Corps plans for the Ala Wai Watershed Flood Mitigation Project will protect Palolo	12. I believe the Corps plans for the Ala Wai Watershed Flood Mitigation Project will protect Makiki	13. I believe the Corps plans for the Ala Wai Watershed Flood Mitigation Project will protect Manoa	14. I believe the Corps plans for the Ala Wai Watershed Flood Mitigation Project will protect the lower Ala Wai Watershed	15. I believe there are better alterna-tives/ possibili-ties to protect the Ala Wai Watershed	16. I believe the Corps will modify its plan for flood mitigation for the Ala Wai Watershed to incorpor-ate my ideas	17. I believe the Corps will modify its plan for flood mitigation for the Ala Wai Watershed to incorporate the community's ideas	18. I believe that the Federal funds are at risk
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	1	1	1	1	1	1	1	2	2	1	2	2	1	1	4	1	1	1

Count	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Totals	52	47	65	61	61	74	74	80	75	71	78	80	77	79	40	74	73	62
Average	2.1	1.9	2.6	2.4	2.4	3.0	3.0	3.2	3.0	2.8	3.1	3.2	3.1	3.2	1.6	3.0	2.9	2.5

Zipcodes	Areas
96813	Honolulu, Punchbowl, pacific Heights
96814	Ala Moana, Makiki Kai, Pawaa
96815	Waikiki, Kapahulu, Diamond Head
96816	Kaimuki, St. Louis Heights, Palolo Valley, Maunalani Heights, Kahala
96821	Wai-Kahala, Kaikupe, Aina Hina, Niu Valley, Kuliouou
96822	Makiki, Manoa
96826	McCully, Moilili

Appendix B: Contribution of SWIFT to Flood Mitigation

During the pause in the project while USACE was awaiting acceptance of the Final State Environmental Impact Statement (EIS), USACE updated its HEC-RAS 1D hydrologic and hydraulic modeling used in preparing its 2017 Feasibility Study to more comprehensive HEC-RAS 1D/2D models to advance the project design. As a result of this work, USACE found that the anticipated reductions in Water Surface Elevations (WSE) expected from the 2017 Feasibility Study could not be achieved with the proposed system features.

Use of the more advanced HEC-RAS 1D/2D models, resulted in a significant increase in the flow rates from the upper watershed that will increase flooding in the middle and lower watershed above earlier predicted levels. USACE reported its new flow rates are 2 to 4 times the size of the data that resulted in the flooding in 2004. The proposed solutions in the 2017 Feasibility Study are not adequate to reduce the flooding to desired levels. USACE requested Oceanit help look for solutions.

USACE Honolulu obtained approval from the USACE Vertical Team to investigate modifications to system features necessary for the system to perform as anticipated and document their recommendations in an Engineering Documentation Report (EDR).

At the request from the PIG, Oceanit began investigating methods to remove the excess water from the upper and middle watersheds. Oceanit reviewed the USACE HEC-RAS 1D/2D models to better understand the scope of the problem. Oceanit talked to USACE about the changes being considered and began to consider alternative solutions that could address the problem.

Oceanit developed a pragmatic plan that would take community needs into account. The community was already concerned about flooding in the lower watershed. With the increased flow from the upper watershed, the community was even more concerned. The community wanted the excess water to be removed quickly to minimize flooding rather than being stored.

After agreeing to the requirements for a solution, Oceanit developed the SWIFT (Subsurface Watershed Inundation Flow Technology) design concept that would utilize tunnels to remove water from the upper watersheds, bypass the lower watershed and the Ala Wai Canal, and discharge directly into the ocean.

Oceanit built a prototype by modelling the proposed solution in HEC-RAS. Oceanit created a physical 3D model of the watershed to better engage the community and communicate options and solutions.

The watershed topography and the flood water discharge from hydrological models were evaluated to initially select tunnel intake locations. Several tunnel inlets and outfalls were selected initially in the upper and middle areas of the three sub watersheds and the nearshore area. Hydraulic calculations were conducted using each of these locations to determine the discharge capacity for a 6-foot diameter tunnel. This indicated the optimum intake location for each of the tunnel intake locations. The ocean discharge was located at the 40 feet depth contour. The calculations were extended to tunnels diameters up to 12 feet in 2-foot increments.

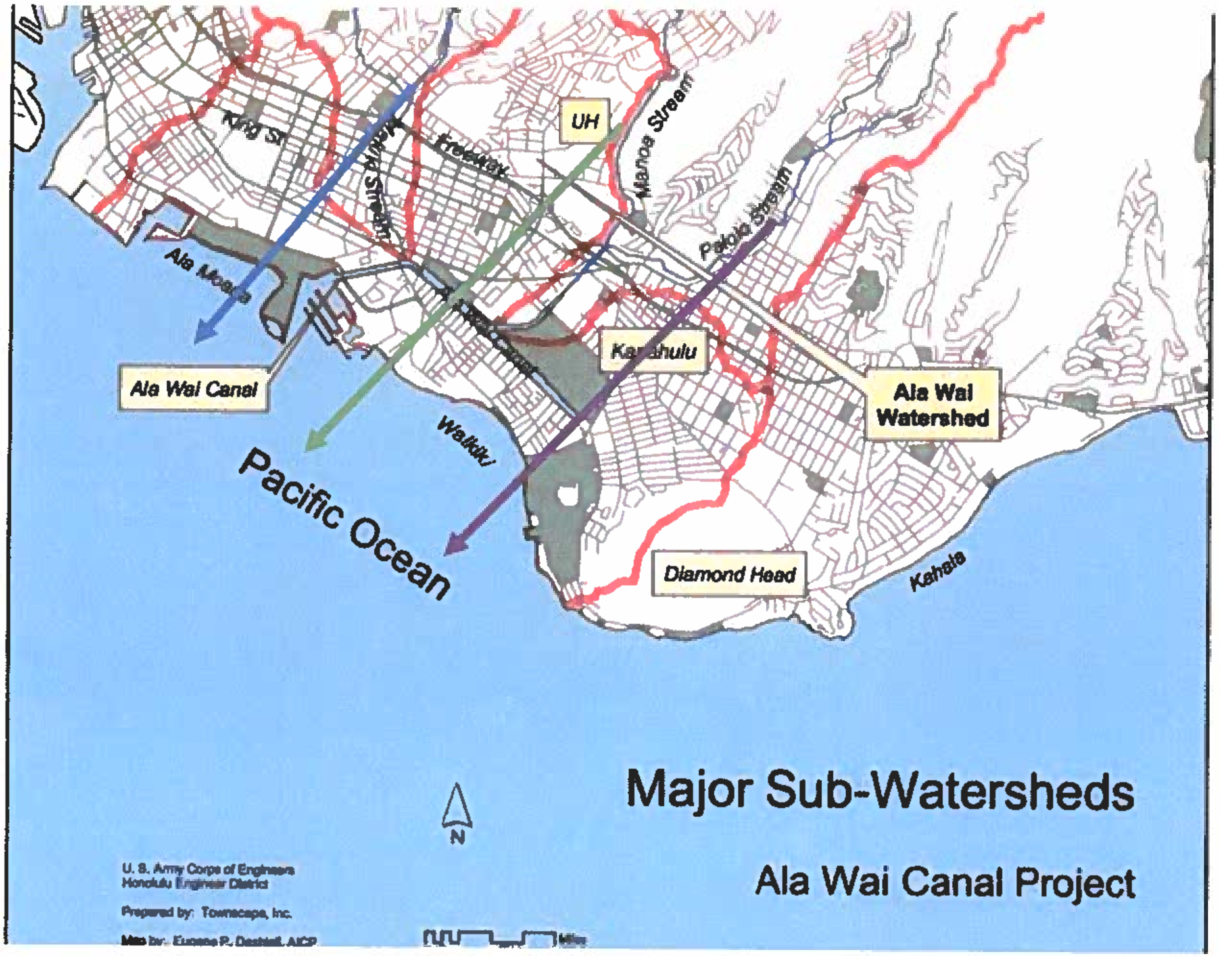

Figure 4 shows the locations and the approximate traces of the three tunnels.

The watershed consists of many sub-watersheds that drain water from different areas into local drainage channels and finally into the Ala Wai Canal through Makiki, Manoa and Palolo streams. Figure 5 shows the hydrological schematic of the watershed feeding the Ala Wai Canal including contributions from the lower Ala Wai watersheds like Waikiki and Kaimuki.

The left portion shows the Makiki watershed schematic with its reaches identified with a "K." The Manoa schematic is in the center with its reaches identified with a "M." The Palolo schematic is on the right side with its reaches identified with a "P."

The water intake points for the tunnels were selected to optimize the tunnel discharge, by evaluating the elevation of the intake point, tunnel length and the tunnel diameter. The optimum intake points for maximizing discharges are identified in the schematic and are shown in green.

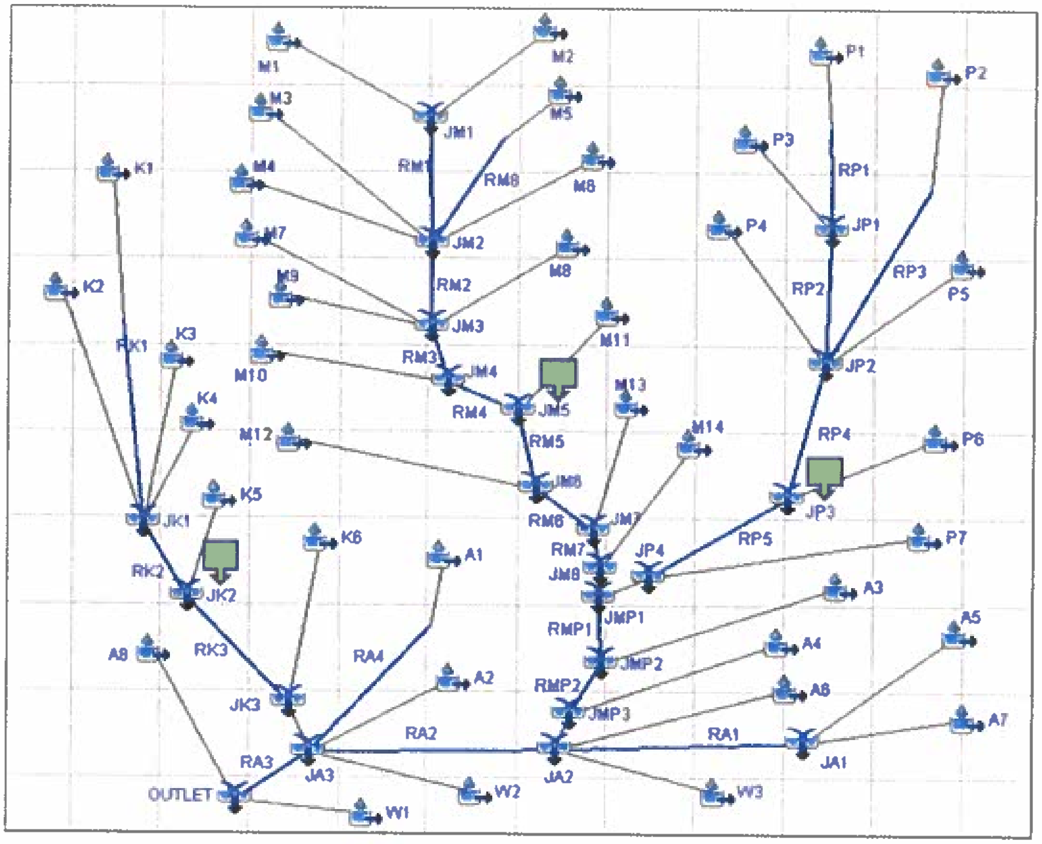

Figure 5 Water Extraction/Tunnel Intake Locations are shown in green on the Hydrologic Map

Tunnel Intake Designations on the Hydrologic Map:

- JK2 Makiki Tunnel Intake
- JM5 Manoa Tunnel intake
- JP3 Palolo Tunnel Intake

Using this information and different size diameter tunnels, Oceanit was able to calculate the amount of discharge in cubic feet per second. Oceanit compared the results against its target goals. (See information in tables below for the tunnels in each watershed.)

Tables 1 through 3 show the amounts of flow extraction with different tunnel diameters for each watershed.

Makiki Watershed Junction JK-2				
Parameter				
Tunnel Diameter Feet	6	8	10	12
Water head Feet	59	59	59	59
Tunnel Length Feet	9,100	9,100	9,100	9,100
Discharge CFS	403	868	1,574	2,559

Table 1. SWIFT discharge for different tunnel sizes for Makiki Watershed

Manoa Watershed Junction JM-5				
Parameter				
Tunnel Diameter Feet	6	8	10	12
Water head Feet	125	125	125	125
Tunnel Length Feet	12,500	12,500	12,500	12,500
Discharge CFS	501	1,078	1,954	3,178

Table 2. SWIFT discharge for different tunnel sizes for Manoa Watershed

Palolo Watershed Junction JP-3				
Parameter				
Tunnel Diameter Feet	6	8	10	12
Water head Feet	110	110	110	110
Tunnel Length Feet	11,200	11,200	11,200	11,200
Discharge CFS	496	1,068	1,937	3,150

Table 3. SWIFT discharge for different tunnel sizes for Palolo Watershed

The tunnels are designed to discharge directly into the ocean and bypass the lower watershed completely. In order to evaluate the resulting flood reduction impact in the Ala Wai Canal vicinity and Waikiki, Oceanit ran the hydraulic models developed by the USACE with the flow elimination simulated at the tunnel starting points (reflected in Figure 5 above).

Oceanit integrated the tunnel concept into the 100-year event HEC-RAS model without features. Initially, Oceanit experimented with using three 10-foot diameter tunnels located in the upper regions of sub-watershed Makiki, Manoa, and Palolo. With the tunnels, the HEC-RAS modeling results showed an elimination of flooding at the University of Hawaii and a notable reduction of inundation in the lower watershed area. For example, flow depth in the McCully-Mo'ili'ili area was reduced by 0.5 feet on average, and up to 1 foot on the east side of Kalakaua Ave. However, due to the widespread inherently large amount of rainfall from a 100-year storm event, the inundation levels in the lower watershed would still be significant, even with the tunnels.

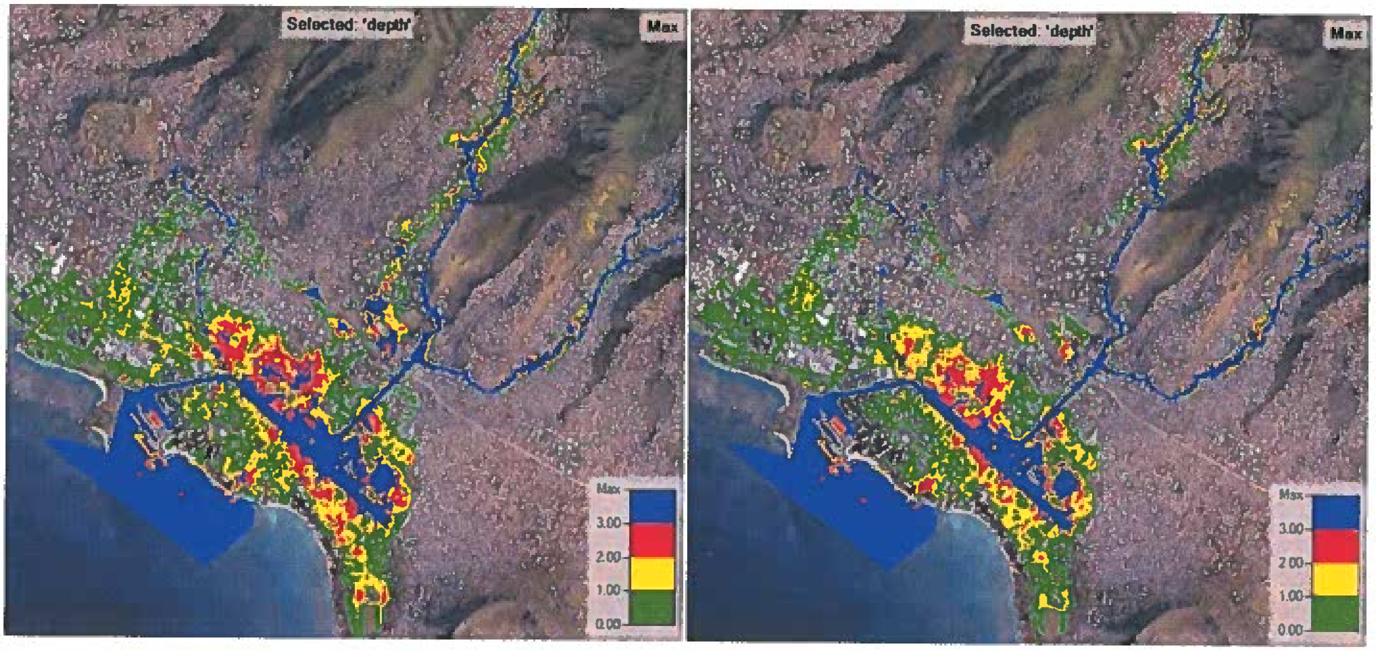

Figure 6 Flow depth comparison of without features (left) versus with three 10ft diameter tunnels at Makiki, Manoa and Palolo (right)

To optimize the SWIFT design, Oceanit performed a series of sensitivity studies using the HEC-RAS models. Oceanit found that the results from the Makiki tunnel were not significant enough to justify the construction costs of the tunnel. After eliminating the Makiki tunnel, Oceanit evaluated the remaining two tunnels with different tunnel diameters.

The comparison of the modeling results showed that the two-tunnel option with the Manoa tunnel at a 12-foot diameter and the Palolo tunnel at a 10-foot diameter achieved the best performance in mitigating flooding in the lower watershed. In the two-tunnel case, flow depth is reduced by 1 foot in both the McCully-Mo'ili'ili and Waikiki areas as compared with USACE's model without features.

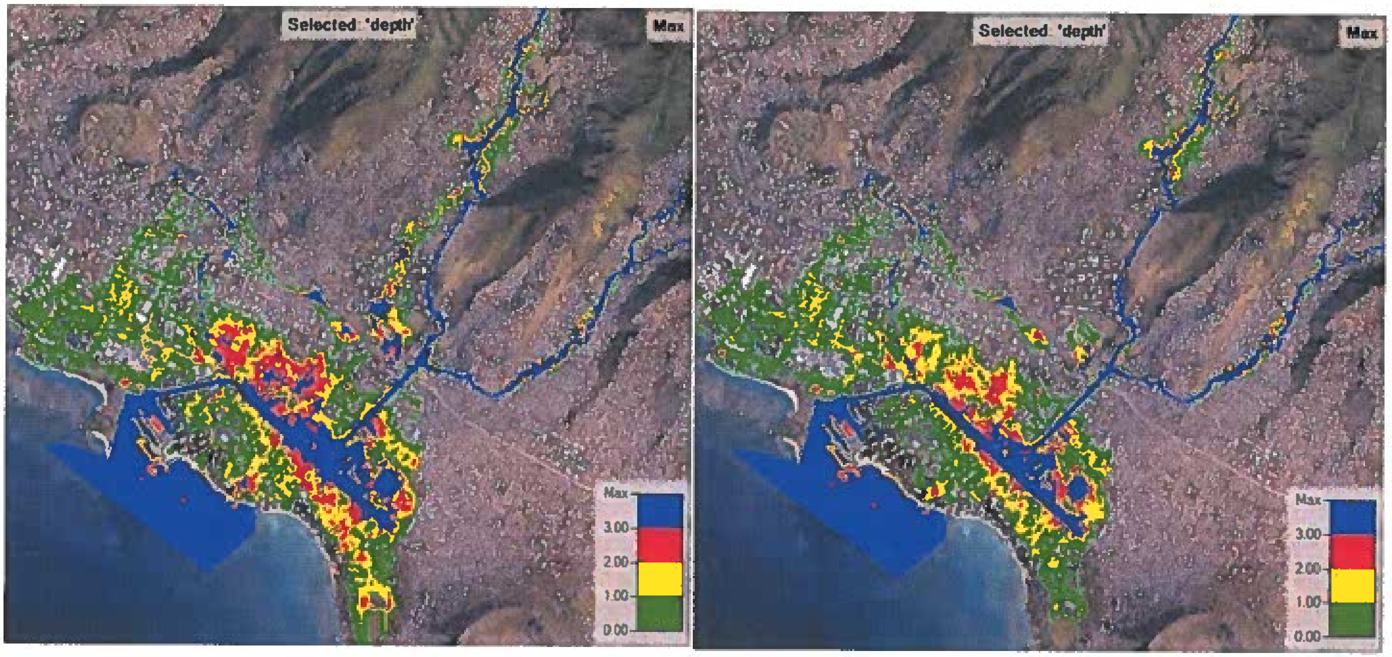

Figure 7 Flow depth comparison of without features (left) versus with 12ft tunnel at Manoa and 10 ft tunnel at Palolo (right)

Oceanit searched for a company with tunnel design and drilling experience to move the project to the design and costing stage. The company subcontracted for this task was Brierley Associates (BA), a drilling company from Texas, currently involved in drilling a tunnel in Honolulu for the Environmental Services Department of the City and County of Honolulu. Their prior services and experience in Hawaii include the construction of the Kaneohe – Kailua Wastewater Conveyance and Treatment Facilities Project.

BA reviewed and analyzed the requirements of the project. They prepared a conceptual design and preliminary cost estimate for the two 12-foot diameter Manoa and Palolo tunnels. Their design consisted of a single 12-foot diameter tunnel for each watershed that ended at the lower watershed in a horizontal manifold with the axis parallel to the shoreline. This portion of the tunnel will be constructed by a tunnel boring machine drilling a 14-foot diameter hole and lining the hole with a 12-foot diameter concrete pipe. This machine is not able to drill into the ocean because of extraction complexities. Three 7-foot diameter tunnels will start from the manifold and end in 40 feet water depth. These will be constructed using micro-tunneling techniques.

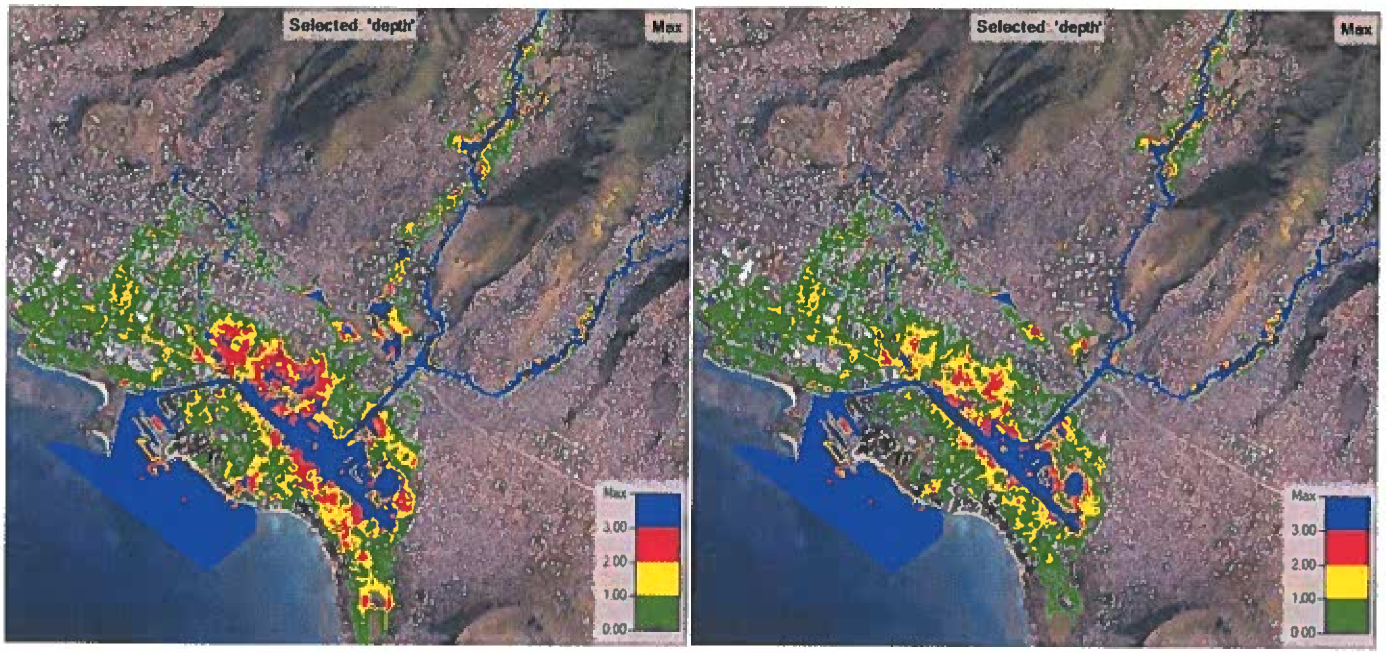

Figure 8 Flow depth comparison of without features (left) versus with 12ft tunnel at Manoa and 12 ft tunnel at Palolo (right)

The schematic below shows the layout of the tunnels with the manifold. A single 12-foot diameter concrete pipe comes into the manifold. The manifold in this case is a larger channel that receives the water from the 12-foot diameter concrete pipe and sends it out to the ocean through three 7-foot diameter tunnels. Figure 6 below shows a schematic of the Tunnel/Manifold Concept.

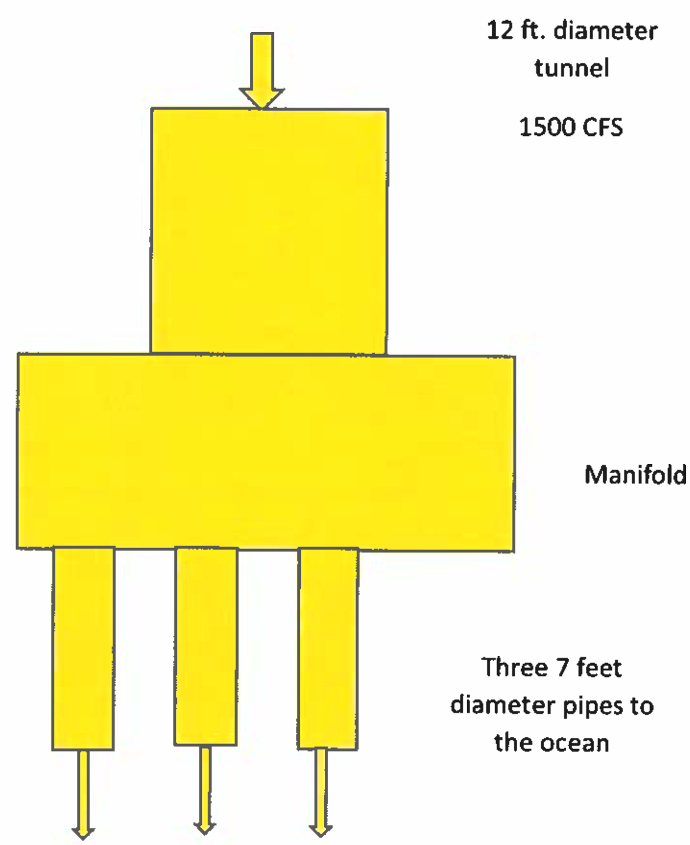

Figure 9 Schematic of the Tunnel Concept

Appendix C: Tunnel Conceptual Design and Cost

BRIERLEY ASSOCIATES
Creating Space Underground

File No. 120170-000
July 10, 2020

Mr. Steve Wilson
Oceanit
828 Fort Street Mall, Suite 600
Honolulu, HI 96813
swilson@oceanit.com

Subject: Ala Wai Storm Tunnels Cost Estimating
Honolulu, Hawaii

Dear Mr. Wilson:

INTRODUCTION

Brierley Associates Corporation (Brierley) is pleased to submit this letter report for preliminary cost estimating services for underground construction for the subject project. Our understanding of the project was based on the following:

- A draft project narrative from Oceanit entitled, "Ala Wai Watershed Flood Mitigation, Impact Of Tunnels On Flooding" provided on June 4, 2020;
- A four-page PDF document with the file name, "Tunnel-Conceptual-Alignment-Profile-Info", provided on June 4, 2020;
- A PDF copy of the USGS Geology of Oahu map from Open-File Report 2007-1089, Sheet 3 of 8 provided on June 18, 2020 in response to Brierley's request for available project geotechnical information;
- Your June 4, 2020 introductory email to Brierley's Mr. Jim Williams and a request for "Estimates for Tunnels"
- A joint Brierley/Oceanit teleconference to discuss the project and context for this proposal on June 10, 2020.
- An updated joint Brierley/Oceanit teleconference on June 26, 2020 to discuss Brierley's initial conceptual design and cost estimating proposal for this project, and to discuss a revised proposal for cost estimating only that better serves your immediate versus longer term project needs.
- A Word document dated July 2, 2020 entitled "Palolo and Manoa Tunnel Profiles" providing anticipated vertical profile information needed to estimate the depths of the intake shafts for the two tunnels.

We understand that the project consists of Oceanit performing conceptual engineering for the City and County of Honolulu (Honolulu) for input to the U.S. Army Corps of Engineers (USACE) for the Ala Wai Watershed flooding abatement study. Oceanit is studying diversion tunnel conveyance alternatives to the USACE plan for detention basins in the upper watersheds of three major drainages north of Honolulu and from Ala Moana Park to the west to Waikiki to the east. We further understand that USACE shifted from an earlier detention model designed to retain more water in detention basins in the upper watersheds to a combined surface conveyance and detention model that puts more water in the lower watershed. Based on community input, Oceanit developed the SWIFT (Subsurface Watershed Inundation Flow Technology) design concept that would utilize tunnels to remove water from the upper watersheds and bypass the lower watershed and the Ala Wai Canal, discharging directly to the ocean.

Although the current tunnel conveyance alternative conceptual design lacks certain feasibility input and refinement with respect to both project layout and likely means and methods, Oceanit requested cost estimating services without further design development at this time due to project schedule and budget constraints. Brierley and Oceanit agreed to various simplifying assumptions outlined below in order for Brierley to reasonably provide tunnel construction cost data.

BACKGROUND

We provided a more detailed discussion of the project background as we understand it in a parallel section of our proposal dated June 30, 2020. That narrative was largely taken directly from Oceanit information about the project cited above and the project updates on their web site. That information is not repeated here.

For the purposes of this work product, we developed cost estimates for two (2) tunnels, one each for the Manoa and Palolo sub-watersheds, both assumed to be the same diameter. Certain other simplifying assumptions agreed to in order to perform this work are listed below.

SCOPE OF WORK AND RESULTS

In order to complete this assignment, we performed two basic scope tasks. Summaries of the scope and results of our work are described in this section.

Task 1 - Review Existing Background Information

This task included a limited project and background geologic/geotechnical review needed to develop conceptual assumptions about the project layout and likely subsurface conditions for each of the two alignments. This was done at a very high level because of available budget and schedule, but did include review of the provided geologic map and other references, as well as conferring with a local Brierley geotechnical colleague who has practiced geotechnical engineering and performed subsurface investigations all around Honolulu for decades.

Both alignments will encounter similar geologic subsurface conditions. Both tunnels are assumed to include main construction shafts on shore, but as close to the shoreline as possible to minimize the lengths of the ocean outfalls. From these shafts approximately 14-ft diameter tunnels will be driven roughly perpendicular the coast by Tunnel Boring Machine (TBM) at a near horizontal grade to near the change in surface topography in the vicinity of Highway H-1. From there the tunnels will be driven uphill at a grade of approximately 2 percent to keep the depths of the TBM retrieval shafts (which will become the storm tunnel intake shafts) as shallow as possible. A maximum grade of 2 percent was used in order to not have too steep a grade for tunnel construction means and methods and safety considerations. The ocean outfalls will be constructed in the opposite direction out of the main construction shafts by installing multiple, approximately 7-ft diameter, pipes using Microtunnel Boring Machine (MTBM) methods. The alignment corridors are approximately shown in Figure 1, but the outfall locations are not specific in this figure.

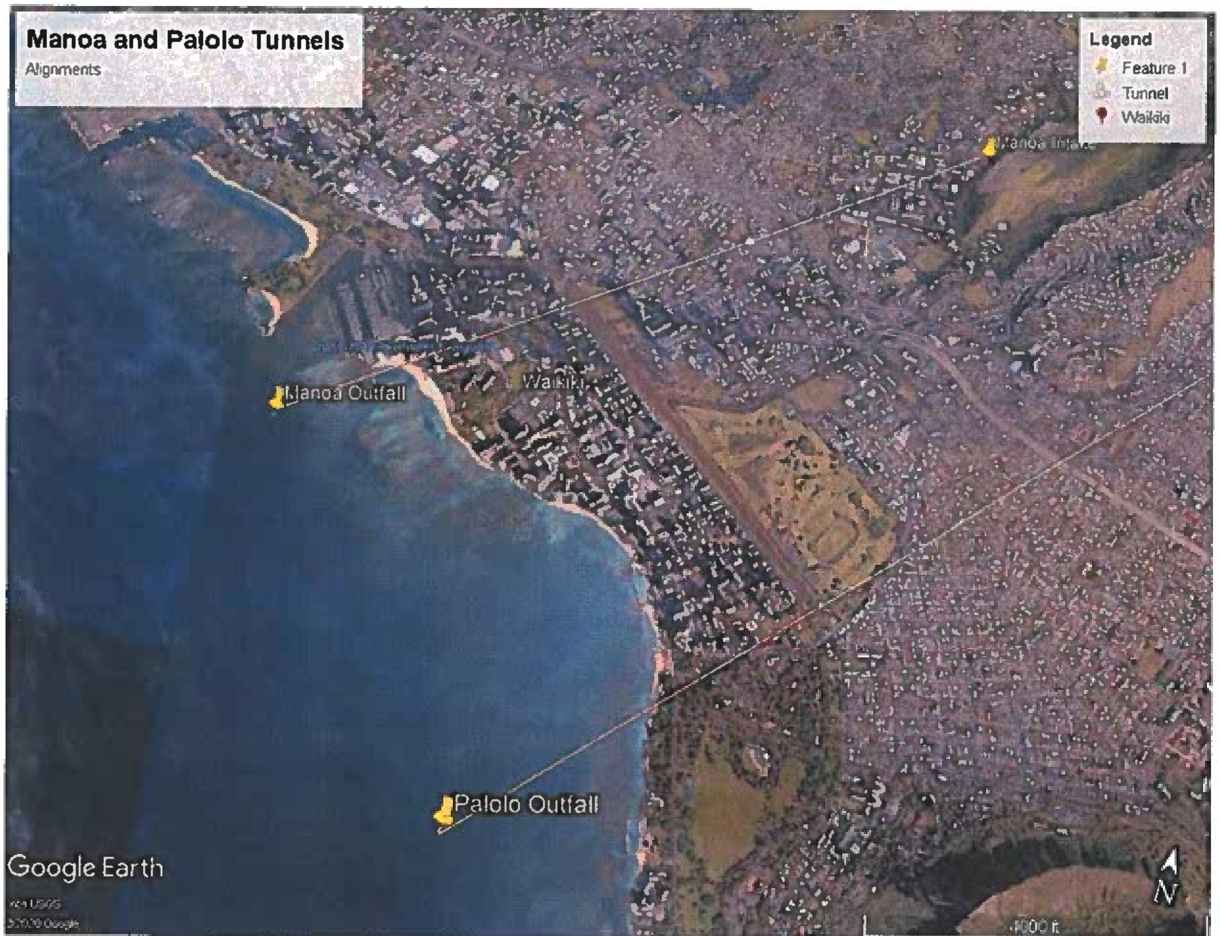

Figure 1 – Approximate Manoa Tunnel and Palolo Tunnel Alignment Corridors

In the vicinity of the main shafts near the coast, anticipated subsurface conditions are assumed to be similar to those in the vicinity of the Beachwalk Wastewater Pump Station to Ala Moana Park Sewer project.[1] The subsurface conditions near the shafts, and heading both inland within the lower coastal plain and offshore to the outfalls are assumed to generally consist of a highly complex local geology that includes highly variable deposits due to the mixing and interfingering of coral, coral reef limestone, beach sand, lagoonal deposits, bedded deposits of alluvial silts, sands, and clays carried down from the mountains, and bedded volcanic deposits. The resulting geology can include bedded tuffaceous silts and sands, more recent alluvial deposits with cobbles and boulders, and interbedded coralline deposits and coral reef limestone, overlain by very soft lagoonal deposits. The youngest sediments are the silts and clays deposited in the Ala Wai Canal.

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[1] "Geotechnical Investigation Report, Beachwalk Wastewater Pump Station to Ala Moana Park Sewer", Yogi Kwong Engineers, LLC, January 2009.

In addition, manmade fill deposits occur locally, mostly as the result of past land reclamation and filling of old marsh lands and taro patches that once existed all around Waikiki. Fills also exist from utility trench backfilling and more recent grading work. Highly variable fill deposits likely exist in the near surface and might include medium stiff to stiff silt, and very loose to very dense coralline and basaltic sands and gravels with cobbles. Fills can also include construction debris like abandoned sheet piles, concrete slabs and miscellaneous other metal, wood and concrete debris. Because of the soft nature of some of the natural soils like the lagoonal deposits, much of the development of buildings in the Waikiki area has been on deep pile foundations. It is likely that the tunnels will encounter foundation piles in this vicinity, but this remains an unknown. It has been assumed that no significant pile obstructions will be encountered by the tunnels at this time.

Progressing towards the mountains, these complex interbedded deposits are expected to thin until the underlying volcanic bedrock rises to the surface and then occurs both in outcrop and at depth in the hills above H-1. The volcanic bedrock is also expected to be highly variable because of the complex history of volcanic activity of the two main volcanoes that comprise Oahu, and because of extensive tropical weathering that has occurred since volcanic activity ceased. Bedrock encountered will likely vary from sound, strong basalt from lava flows to cinder and ash deposits from more explosive volcanic events. Some of the more or less stratified tuffaceous deposits may have become welded and strong (welded tuff) under its own weight and heat. In other places it could have remained weak and friable.

For the purposes of our cost estimates, we have assumed single, "crossover" TBMs that can excavate both weak, saturated soil deposits near the coast and strong bedrock near the mountains will be employed. These machines can operate in "pressure face" mode using Earth Pressure Balance (EPB) technologies to maintain tunnel face stability in weak soils. They can also be operated in "open" mode in stable bedrock. The TBM cutterhead configuration can be modified with the machine underground for the transition from soils to rock. We assumed the same production rate for both the soil and rock reaches at this time, the limits of which are unknown, but we included an assumption of encountering 2000 LF of "bad ground" (likely in the soil reaches) that will require a reduced production rate of one-half of that assumed for the rest of each tunnel.

<u>Task 2 - Perform Cost Estimates for Two (2) Storm Tunnels and Near-shore Outfalls</u>

This task involved developing conceptual design level cost estimates for the two tunnels, the Manoa Tunnel and the Palolo Tunnel. Our approach was to develop costs in general accordance with methods proposed by ACEE (2005). Table 1 below shows the relationship between cost estimate class and level of project definition. At this time, with no geotechnical information, only an initial concept level design, and some level of approximation required for unknowns associated with the marine work, we believe that a Class 5, Conceptual Screening cost estimate is suitable for the present project status. More work is needed to develop the project design to the Class 4, Study or Feasibility level. Based on this characterization, and ACEE guidance, the cost estimates we provide should be considered to have an accuracy range of up to -50% to +100% relative to the base estimates.

	Primary Characteristic	Secondary Characteristic			
ESTIMATE CLASS	LEVEL OF PROJECT DEFINITION Expressed as % of complete definition	END USAGE Typical purpose of estimate	METHODOLOGY Typical estimating method	EXPECTED ACCURACY RANGE Typical variation in low and high ranges [a]	PREPARATION EFFORT Typical degree of effort relative to least cost index of 1 [b]
Class 5	0% to 2%	Concept Screening	Capacity Factored, Parametric Models, Judgment, or Analogy	L: -20% to -50% H: +30% to +100%	1
Class 4	1% to 15%	Study or Feasibility	Equipment Factored or Parametric Models	L: -15% to -30% H: +20% to +50%	2 to 4

Table 1: Cost Estimate Classification Matrix (ACEE, 2005)

Using this approach, we developed detailed, "bottom up" cost estimates for each tunnel separately using the same set of assumptions. In addition, the same costs were used for the near-coast construction shafts and the MTBM outfall manifolds for each tunnel, which are assumed to be identical. The cost tables provided in Appendix A provide detailed cost summaries for the two tunnels, including the major cost categories that were used to build the estimates. A list of important cost estimate assumptions and exclusions follows applicable to the cost estimates is provided below.

The total estimated construction costs rounded to the nearest $100,000 from the calculated costs for the Manoa and Palolo Tunnels are as follows:

- Manoa Tunnel = $135,700,000 (10,500 LF @ 12-ft dia. + 3 X 2,000 LF @ 7-ft dia.)
- Palolo Tunnel = $126,100,000 (9,200 LF @ 12-ft dia. + 3 X 2,000 LF @ 7-ft dia.)
- Both Tunnels = $261,800,000

The following list of additional assumptions in addition to those already noted above were made to prepare our cost estimates for this project.

1. Various alternatives discussed between Oceanit and Brierley were simplified to a single alternative approach and a single tunnel diameter for the two alignments.

2. Each tunnel alignment includes "tunnel" alignments (onshore and offshore lengths) of the lengths provided initially by Oceanit. 2000 LF MTBM driven outfall manifolds are included and 2000 LF was subtracted from the overall alignment lengths to establish the lengths of the main TBM tunnels.

3. The TBM tunnels were sized to 12-ft finished diameter. We assumed two new 14-ft (4.25 m) diameter "crossover" TBMs at approximately $10.5M each plus backup TBM equipment at an additional 40 percent, or approximately $15M per TBM.

4. We assumed two TBMs operating simultaneously for schedule with a one-pass concrete segmental lining installed immediately behind the TBM serving as the carrier pipe.

5. We assumed TBM production of 60 LF/day working two 10-hour shifts plus one 4-hour maintenance shift, with 2000 LF of each tunnel discounted to 30LF/day to account for some percentage of "bad ground" as noted above.

6. Each tunnel alignment will include two (2) constructions shafts.
   a. Two main TBM/MTBM access shafts as close to the coastline as possible. The TBMs will drive "uphill" from there towards the intake shafts and the MTBM drives will drive under the ocean from there to submerged sheet pile caisson built in about 40-ft of water depth; and
   b. Two TBM retrieval shafts at the tunnel intake locations at the uphill ends of the alignments where the TBMs will be retrieved after completing each drive.

7. The coastline shafts will also be used to launch three (3) MTBM drives out to submerged caissons to create an outfall manifold. For 12-ft finished inside diameter tunnels into the shaft, three MTBM drives approximately 7-ft in diameter will be needed for the MTBM outfall pipes.

8. The MTBM drive and marine work costs are based on cost information provided by experienced Honolulu contractors specializing in this work for use by Brierley for this project.

9. No hydraulics analysis was performed to evaluate the transitions from TBM main tunnels to multiple MTBM outfalls. MTBM drives assume a maximum length of 2000 LF because this length is approximately the maximum reasonable MTBM drive length assumed possible without intermediate jacking stations (IJS) or intermediate jacking pits, which are not feasible offshore.

10. No provisions for intermediate outfall shaft locations to provide optional discharges to the Ala Wai Canal during lower flow conditions are included, but may be a project feature of interest in the future.
11. No provisions are included for possible seabed pipelines extending beyond the near-shore outfall terminus points to carry effluent farther offshore into deeper water as may be required for environmental reasons.

12. No intake or outfall "structures" or plumbing are included, just the shafts in which these structures could be built prior to backfilling.

13. The construction cost estimates do not include design or construction management costs.

14. No provisions or cost considerations are included for permitting, easements, ROW or property acquisitions, or environmental considerations.

CLOSING

The Ala Wai Storm Tunnel is a very interesting and challenging project. We are pleased to have been contacted by Oceanit and had this opportunity to assist them and Honolulu in evaluating possible tunnel conveyance alternatives to alleviate storm flooding risk. We look forward to learning how the project progresses from here and to the opportunity of working with you further should the project require additional tunnel engineering support. Please contact either of the undersigned with any questions or comments.

Sincerely,
BRIERLEY ASSOCIATES CORPORATION

Don Painter
Senior Tunnel Consultant

Alan L. Howard, PG, CEG
Principal

Attachments: Appendix A – Detailed Cost Estimate Summaries

APPENDIX A – DETAILED COST ESTIMATE SUMMARIES

FEASIBILITY LEVEL COST ESTIMATES FOR TUNNEL CONSTRUCTION

PRICES BASED ON 9200 LINEAR FEET x 168" DIA. PALOLO TUNNEL (TBM)

6000 LINEAR FEET (MTBM)

TBM TUNNEL AND SHAFT ESTMATES

1.	Labor:	$4,252,500.00
2.	Plant Equipment:	$20,205,450.00
3.	Consumables:	$1,328,400.00
4.	Materials:	$10,302,300.00
5.	Tunnel Subcontracts:	<u>$5,824,320.00</u>

PRICE BASIS FOR PALOLO LAUNCH SHFT 50-0" x 40-0" x 44'-0"

1.	Labor:	$1,477,560.00
2.	Shaft Plant Equipment:	$175,650.00
3.	Consumables:	$31,650.00
4.	Subcontract:	$385,000.00
5.	Temporary Shaft Support Subcontract:	$664,800.00
6.	Ground Treatment for TBM and MTBM Launch	<u>$936,000.00</u>

PRICE BASE FOR PALOLO TBM STARTER TUNNEL 250'-0" x 16'-0" x16'-0"

1.	Labor:	$544,390.00
2.	Plant Equipment:	$186,575.00
3.	Consumables:	$437,650.00
4.	TBM Assembly, Installation, and Launch:	<u>$1,500,000.00</u>

MTBM INSTALLATION-3 x 2000Lf. 84" RCP WITH WET RECOVERY x 3

MARINE INSTALLED COFFER DAMS.

1.	Subcontract estimated quotes:	<u>$36,325,000.00</u>

PRICE BASE FOR PALOLO INTAKE TBM RECOVERY SHAFT

SHAFT DIMENSION- 30'-0" DIAMETER X 47-0" VF

1.	Labor:	$194,320.00
2.	Equipment:	$125,000.00
3.	Consumables:	$13,950.00
4.	Materials:	$330,000.00
5.	TBM Retrieval:	<u>$35,000.00</u>

BARE TOTAL PALOLO INSTALLATION: $82,946,515.00

PRICES BASED ON 10,500 LINEAR FEET x 168" DIA. MANOA TUNNEL (TBM)

6000 LINEAR FEET (MTBM)

TBM TUNNEL AND SHAFT ESTIMATES

1.	Labor:	$5,348,130.00
2.	Plant Equipment:	$20,814,150.00
3.	Consumables:	$1,496,417.00
4.	Materials:	$11,742,100.00
5.	Tunnel Subcontracts:	$6,498,440.00

PRICE BASIS FOR MANOA LAUNCH SHAFT 50'-0" x 40'-0" x 44'-0"

1.	Labor:	$1,477,560.00
2.	Shaft Plant:	$175,650.00
3.	Consumables:	$31,650.00
4.	Shaft Subcontract:	$385,000.00
5.	Temporary Shaft Support Subcontract	$664,800.00
6.	Ground Treatment for TBM and MTBM Launch	$936,000.00

PRICE BASIS FOR MANOA TBM STARTER TUNNEL 250'-0" x16'-0" x16'-0"

1.	Labor:	$544,390.00
2.	Plant Equipment:	$186,575.00
3.	Consumables:	$437,650.00
4.	TBM Assembly, installation, and launch:	$1,500.00.00

MTBM INSTALLATION 3 x 2000LF=6000LFX 84" RCP WITH WET RECOVERY

MARINE INSTALLED COFFER DAMS

1.	Subcontract estimated quotes:	$36,325,000.00

PRICE BASIS FOR MANOA INTAKE TBM RECOVERY SHAFT

SHAFT DIMENSION 30'-0" DIA. X 67'-0" VF

1.	Labor:	$302,390.00
2.	Plant Equipment:	$229,200.00
3.	Consumables:	$28,525.00
4.	Materials:	$394,400.00
5.	TBM Retrieval:	$35,000.00

BARE TOTAL MANOA INSTALLATION $89,190,377.00

TOTAL BARE COST ESTIMATE FOR MANOA AND PALOLO INSTALLATIONS: $172,136,892.00

INDIRECT (IND P) ESTIMATED COSTS FOR PALOLO

Resource ID	Description	Unit Rate	Unit Qty.	Total
IND P 1.	Mobilization	0.08	$82,946,515.00	$ 6,635,722.00
IND P 2.	Bond & Insurance	0.02	$82,946,515.00	$1,658,930.00
IND P 3.	Overhead & Profit	0.15	$82,946,515.00	$12,441,977.00
IND P 4.	Contingency	0.25	$82,946,515.00	$20,736,629.00
IND P 5.	Demobilization	0.02	$82,946,515.00	$1,658,930.00

Total Indirect Cost Palolo-	$43,132,188.00
Total Direct Cost Palolo-	$82,946,515.00
Total Direct Cost-Plus Indirect Cost Palolo-	$126,078,703.00

INDIRECT (IND M) ESTIMATED COSTS FOR MANOA

Resource ID	Description	Unit Rate	Unit Qty	Total
IND M 1.	Mobilization	0.08	$89,190,377.00	$7,007,166.00
IND M 2.	Bond & Insurance	0.02	$87,589,577.00	$1,751,792.00
IND M 3.	Overhead & Profit	0.15	$87,589,577.00	$13,138,437.00
IND M 4.	Contingency	0.25	$87,589,577.00	$21,897,394.00
IND M 5.	Demobilization	0.02	$87,589,577.00	$1,751,792.00

Total Indirect Cost Manoa-	$46,546,581.00
Total Direct Cost Manoa-	$89,190,377.00
Total Direct Cost-Plus Indirect Cost Manoa-	$135,736,958.00

TOTAL COST BOTH INSTALLATION COMBINING DIRECT AND INDIRECTS COSTS $261,815,661.00

Appendix D: Summary of USACE Engineering Documentation Report (EDR)

Overview of the USACE 2020 Engineering Documentation Report with Supporting Comments

ES-1 Purpose of the Engineering Documentation Report

The purpose of the EDR is to document the:

1. Technical analysis completed following Congressional authorization of the project for construction,
2. Identify system modifications and the technical basis for those recommendations, and
3. Provide the engineering and data foundation for a future Validation Study.

The EDR is not a decision document. It solely investigates project feature modifications from a technical perspective. Final recommendations related to modifications of project features will be made with full consideration that modifications to project features are technically sound, economically justified, and environmentally and socially acceptable. This work will occur jointly through completion of a Validation Study and supplemental National Environmental Policy Act (NEPA) document.

ES-2 2017 Project Objective, Scope and Authorization

The project objective is to reduce the depth and lateral extent of overland inundation during a 1% Annual Estimated Probability (AEP) storm event.

In response to identified flood-related issues and opportunities, a series of flood risk management measures were identified during the 2017 Feasibility Study: six in-stream debris and detention basins in the upper reaches of Makiki, Manoa, and Palolo streams, one standalone debris catchment, three multi-purpose detention areas in open spaces throughout the developed watershed, floodwalls averaging 4 feet high along both sides of approximately 1.9 miles of the Ala Wai Canal, two pump stations, and an early flood warning system.

The Record-of-Decision approving the 2017 Feasibility Study was signed in September 18, 2018 by the Assistant Secretary of the Army for Civil Works (ASA (CW)) and funded by the Bi-Partisan Budget Act (BBA) of 2018, (P.L. 115-123), under the Long-Term Disaster Recovery Investment Program for an authorized cost of $345,076,000. The program allows for single phase design and construction, as well as a deferred payment option, to expedite funding and execution of projects.

ES-3 2020 Updated Modeling Results and EDR Feature Recommendations

During the pause in the project while USACE was awaiting approval of the Final State EIS, USACE updated its HEC-RAS 1D hydrologic and hydraulic modeling to more comprehensive HEC-RAS 1D/2D models to advance the design. USACE observed significant differences between the two model results most notably (i) more extensive inundation across the base of the watershed and (ii) the anticipated water surface elevation reductions anticipated were not realized due to insufficient detention capacity and flow constraints along the routing. USACE found that the anticipated reductions in Water Surface Elevations (WSE) expected from the 2017 Feasibility Study could not be achieved with the authorized system features. Consequently, modifications to the risk management features were evaluated to mitigate these emergent findings.

Central to the USACE 2020 modified approach is a shift in concept from temporary storm water detention in the upper watersheds to enhanced conveyance within existing routing throughout the watershed. The proposed changes to the 2017 Feasibility Study outlined in this 2020 EDR modifications include (i) the removal of six detention basins from the upper watershed, (ii) the addition of limited flood walls at two locations, upstream of the Woodlawn Bridge, and the reach between Date Street to the Ala Wai canal, (iii) the addition of two bypass diversion culverts around the Woodlawn Drive Bridge stream reach and at the base of the Makiki channel into the Ala Wai Canal, and (iv) the consolidation of two pump stations into a single larger pump station.

Validation study will bring above concepts to design level required for supplemental NEPA analysis.

Project Objective

The objective of the Ala Wai Canal Flood Risk Management Project is to reduce riverine flood risks during a 1% Annual Estimated Probability (AEP) storm event in the Ala Wai Watershed. Flooding associated with a 1% AEP 24-hour rainfall event would affect approximately 1,358 acres within the Ala Wai Watershed, including over 3,000 properties with an estimated $1.14 billion in structural damages at 2016 price levels. All routing, mapping, and design concepts were based on the 1% AEP storm event for the purpose of reducing, but not eliminating overland inundation.

The reconnaissance phase request was initiated by the State of Hawai'i Department of Land and Natural Resources (DLNR) in April 1999, who sought a comprehensive management and restoration plan to restore aquatic habitat and biological diversity in the Ala Wai Canal and upstream tributaries.

Ala Wai Flood Study was completed in 2001, documenting a high flood hazard associated with potential overtopping of the Ala Wai Canal. The study was initiated by request of the DLNR Land Division in September 1998, to determine the potential flood risk to the Waikiki area.

The Manoa Watershed Project was initiated in 2006 by the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), following a 2004 flood that resulted in approximately $85 M in damages to Manoa, which also encompasses the University of Hawaii.

In 2007, the project re-started, incorporating the information developed in the Manoa Watershed Project. However, in 2012, ecosystem restoration was eliminated as a study objective, as it was determined that the biological resources within the watershed had regional significance however not sufficient national significance to adequately justify ecosystem restoration as an objective.

The project was renamed from Ala Wai Canal Project to Ala Wai Canal Flood Risk Management Project prior to the release of the final 2017 Feasibility Study with Integrated Environmental Impact Statement (FEIS).

The Project was funded for Construction by the Bi-Partisan Budget Act of 2018 (P.L. 115-123) under the Long-term Disaster Recovery Investment Program with an authorized cost of $345,076,000.

Why Change the 2017 Feasibility Study?

From project authorization and funding in September 2018 through April 2020, the USACE preconstruction engineering and design (PED) phase largely consisted of progressing the Hydrologic Engineering Center's River Analysis System (HEC-RAS) 1-dimensional (1D), steady state hydrologic and hydraulic modeling developed to support the 2017 Feasibility Study to more comprehensive HEC-RAS 1D/2D models to advance the design. It also included the development of potential system modifications to mitigate and incorporate model results in order to achieve the Congressionally authorized level of risk reduction. In a brief overview, HEC-RAS 1D/2D model results indicated the desired benefits could not be achieved with the originally planned flood risk management system without modifications. In concept, the system modifications contemplated entailed a shift from temporary detention in the upper watersheds, to improving conveyance through densely urbanized areas until flow discharge into the Ala Wai Boat Harbor.

The modeling used an updated software application (HEC-RAS v5.0.7) to incorporate unsteady state flow. With improved simulation capabilities, HEC-RAS 1D/2D integrates the timing of storm flows, 2-dimensional analysis, more refined terrain elevations, and comprehensive precipitation data to more accurately approximate multi-directional overland flow patterns.

Terrain and topography input were improved with the use of Light Detection and Ranging (LIDAR) remote sensing survey data across the project area.

The input for precipitation was estimated based on the NOAA Atlas 14 database using the average rainfall across the entire basin, consistent with the approach used in the Feasibility Study for equivalent comparison.

The following summarizes the key findings from the HEC-RAS 2D modeling effort.

- Insufficient Detention - the capacity volume and retention time in the detention basins were insufficient to achieve the benefits modeled in the Feasibility Study. Capacity as modeled in the feasibility study was not possible, given the physical constraints at a number of sites,
- Overbank Storage - improved terrain data combined with the greater capabilities of 2D simulation allowed more accurate overbank storage calculations, which significantly changed the volume distribution of flood water in the system,
- More Accurate Boundary Conditions – more accurate topographic data facilitated the development of more representative boundary conditions, which reduced lateral constraints and broadened the extent of inundation at the base of the watershed,
- In-Stream Impediments – Unsteady state modeling combined with 2D capabilities allowed improved simulation of in-channel constraints which forced flow out of bank at multiple bridge crossings, and
- Increased Out-of-Bank Routing - better quality terrain data identified areas of lower elevations with hydraulic connectivity, where rather than going into storage, flow overtopped the channel banks and increased localized pooling and inundation.

This resulted in more water flow from the upper watershed and more extensive inundation across the base of the watershed.

Goals for the EDR

Following the HEC-RAS 1D/2D results, USACE found the desired benefits could not be achieved with the originally planned flood risk management system (2017 Feasibility Study) without modifications. Modifications to the system and the 2017 Feasibility Study were evaluated to achieve the intended benefits and evaluations including: (1) increasing the storage capacity by raising the top of the detention basins and floodwall heights, (2) expanding the storage capacity of the detention basins through excavation, (3) re-siting the structures to more suitable locations, and (4) increasing detention times by optimizing discharge rates from the basins using flow control methods.

EDR Changes to the 2017 Feasibility Study

The 2017 Ala Wai Canal Feasibility Study was updated with the following major changes:

1. The Ala Wai Floodwall cross section has become more robust to include deep sheet pile for seepage and piles for stability. Additionally, it has become taller and been located farther from the canal, which now conflicts with roadways, curb and gutters, lighting, traffic signs, and trees.

For the purposes of the Rough-Order-of-Magnitude cost estimate, a conservative T-wall foundation system vice a less extensive foundation system proposed during the feasibility phase has been included to incorporate findings from the 1D/2D modeling. A global stability analysis which will provide additional engineering details to help clarify the most suitable foundation system is in progress and scheduled for completion in August 2020.

2. The Ala Wai Floodwall length has been reduced by approximately 4,000 linear feet on the southern alignment from the eastern terminus at the library to the confluence of the M-P Channel and Ala Wai canal.
3. The number of pump plants has been reduced by one. However, the pumping capacity has greatly increased from 1337 cfs/pump plant to 4000 cfs. Additionally, the pump plant now crosses the Ala Wai Canal, where before it was located on land.
4. The length of the golf course levee has been reduced based on the new location almost cutting the golf course in half. A weir option has been included; however, the sediment basin has been eliminated.
5. A floodwall has been added along the M-P Channel extending from the Ala Wai Canal northward to Date Street.
6. A flood control structure has been added along the Makiki Stream, and the Hausten Ditch flood control structure has been relocated farther upstream.
7. A stream diversion structure has been added to divert the Makiki Stream to a different entry point into the Ala Wai canal.
8. Floodwalls have been added to the Manoa Stream upstream of Woodlawn Bridge.
9. Channel deepening has been added downstream of the Woodlawn Bridge.
10. The Manoa Stream in-stream catchment basin has been deleted.
11. Six upper watershed detention basins have been identified for elimination and funds reallocated: Makiki Debris/Detention Basin (D/DB), Waihi D/DB, Waiakeakua D/DB, Woodlawn Ditch DB, Waiomao D/DB, and Pukele D/DB.
12. A berm along the southern side of Manoa Valley District Park has been added.
13. The elimination of the mitigation measures at Falls 7/8 and the associated adaptive management. In the future, mitigation measures and alternatives will be added based upon the updated project features and environmental impact analysis.

ES-4 Draft Cost Estimate and Economics

Project First Cost for the recommended modifications at Budget Year 2020 levels is $376M, including a 29% contingency, $48M. The median preliminary rough-order-of-magnitude Benefit-to-Cost Ratio is 2.48. These metrics will be revised as more engineering details are developed.

EDR Total Project Cost Estimate

Total Project Cost Budget Year 2020 based on 10% Level of Design

	Project First Cost Oct. 2019 ($K) w/o Contingency	% Contingency	Project First Cost Oct. 2019 ($K) with Contingency	Total Project Cost- Fully Funded[1] ($K)
01 Land and Damages	$2,963	27.5%	$3,776	$3,951
Construction				
02 Relocations	$15,707	29%	$20,262	$22,660

04 Dams	$3,767	29%	$4,860	$5,435
09 Channels and Canals	$1,428	29%	$1,842	$2,060
11 Levees and Floodwalls	$66,098	29%	$85,267	$95,359
13 Pumping Station	$128,000	0%	$128,000	$142,088
15 Floodway Control/Diversion Struct.	$43,734	29%	$56,417	$63,094
18 Cultural Resource Preservations	$440	29%	$567	$634
19 Buildings, Grounds & Utilities	$306	29%	$394	$438
TOTAL CONSTRUCTION COST	**$259,480**		**$297,609**	**$331,768**
30 Planning, Engineering and Design	$38,860	14.7%	$44,562	$47,503
31 Construction Management	$25,907	14.7%	$29,708	$34,071
DRAFT PROJECT COST TOTAL	**$327,210**		**$375,655**	**$417,293**

[1] Total Project Cost (TPC) - includes contingency and escalation

ES-5 Environmental Considerations

The recommendations in this EDR have not gone through the rigorous or required NEPA analysis, such as Endangered Species Act, National Historic Preservation Act, Clean Water Act, nor has agency coordination been initiated for the recommendations. As part of a Validation Study in the next phase, the conceptual recommendations presented in this EDR will be advanced in design to conduct the appropriate level of supplemental environmental analysis. Commensurate with the level of supplemental environmental analysis, a supplemental environmental document will be developed and included in the Validation Study.

(Note: USACE reported in the August 12th ELT Meeting it is their intent to follow the spirit of HRS 343 when preparing their NEPA documentation to facilitate preparation of a State EIS.)

System Optimization Analysis - Details of the Proposed Modifications

Proposed Modification and Path Forward (Makiki)

After evaluating several modifications and optimizations, it was determined that detention basin(s) located in the upper watershed of Makiki Valley will not achieve the required risk reduction, particularly when considered relative to an estimated $22M construction cost. Therefore, pending final evaluation during the Validation Study, the detention basin in Makiki Valley has been removed from the flood risk management system in the absence of an effective engineering solution. Findings from the hydrologic and hydraulic analysis in Makiki Valley necessitated a conceptual shift from maximizing flood water detention to enhanced conveyance to manage flood risk.

To manage the storm flow at the base of the watershed, a 1,500 linear foot by 20-foot wide and 10-foot deep box culvert beginning immediately east of the confluence of the Makiki channel with the Ala Wai Canal (Figure 10) was included in the system solution.

The diversion culvert increases channel capacity to handle the backwater flooding in Makiki Stream at its confluence with the Ala Wai Canal as well as collect and reroute overland flow that would normally flow into the canal but is now blocked by floodwalls near the Hawai'i Convention Center. The impact to Water Surface Elevation (WSE) has not yet been fully evaluated yet, evaluation of performance optimization, environmental impacts, and cost effectiveness will occur part of the Validation Study.

Figure 10 Conceptual footprint of Makiki Diversion

In summary, removal of the detention basin from the upper Makiki Valley and the addition of a diversion culvert at the base of the Makiki channel is recommended. HEC-RAS 1D/2D System Model (Manoa Modification 9), incorporates this recommendation.

Upper Watershed (Central) – Manoa Valley

Numerous options were evaluated to maximize the flood risk management benefits in Manoa Valley and throughout the Ala Wai system.

Proposed Modification and Path Forward (Manoa) - The recommended system modification for the Manoa Valley is Modification 9 which can be seen in Figure 11. The modifications consists of (a) stream deepening with a natural bedrock bottom to increase capacity, improve grade to enhance in-channel flow, and help reduce reoccurring sedimentation at the Woodlawn Drive Bridge (b) floodwalls along the Manoa Marketplace reach tying into the Woodlawn Drive Bridge where flood waters historically leave the stream; these floodwalls are essentially an extension of existing walls north of East Manoa Road Bridge, and (c) a box culvert bypass to capture, re-route, and return approximately 1,100 cubic feet per second of excess flow around the constriction at the Woodlawn Bridge to the Manoa Stream.

Figure 11 Woodlawn Bridge modifications as proposed in Modification 9 System Model

Flood proofing the bridge to effectively address potential debris blockages at the bridge was evaluated, determined viable, and will be addressed during the Validation Study and detailed design phases. Areas of additional engineering effort, NEPA evaluation, and community input to better assess cost, community, and environmental impacts include (a) spatially varied rainfall estimates within valley sub-basins, (b) alternate bypass routing and optimization, which may include additional debris catchment features and floodwalls upstream (c) the use of Manoa District Park as a potential detention basin, and (d) berm height adjustments at the Kanewai field. These features will be further assessed for estimated cost, economic benefit, and environmental impacts during the Validation Study with supplemental NEPA efforts.

Palolo Valley

Numerous modifications were qualitatively evaluated to maximize the flood risk management benefits in Palolo Valley and throughout the Ala Wai system.

Proposed Modifications and Path Forward (Palolo) - The features developed in the feasibility phase and numerous modifications evaluated during the PED phase do not significantly reduce localized flooding or WSE at its confluence with Manoa Stream. Therefore, it is recommended that the detention basins in Palolo Valley be removed from the risk management system when considered collectively with the limited, relatively shallow inundation, an estimated $37M of construction costs, land acquisition requirements, and the unwanted impacts to the environment and community.

Lower Watershed

Golf Course Detention Basin

Several modifications were considered for this feature to maximize the volume of temporary storage and concurrently allow overland flow from upland sources north and east through the golf course to the canal without impediment. The berm alignments were also considered as a key component of a floodwall system to manage risk

Proposed Modification and Path Forward (Golf course) - The modified berm alignment illustrated in Figure 12 is recommended to maximize flood water storage and facilitate overland flow to the canal. Additional modifications to the floodwalls are discussed in the following section. Further economic and environmental impacts will be evaluated during the recommended Validation Study with supplemental NEPA efforts.

Figure 12 Flood barrier system alignment and modifications at the Ala Wai Golf Course

Floodwalls and Pump Station

Numerous modifications were evaluated to maximize the efficacy of the flood barrier system which included:

1. Optimizing berm alignments around the Golf Course detention basin to maximize storage capacity
2. Extending floodwalls up feeder sources to the Ala Wai
3. Consolidating and relocating the two planned pump stations
4. Expanding detention along the canal where practicable
5. Expanding existing interior drainage capacity in combination with smaller pump plants
6. A single, high capacity pump plant with a miter gate spanning the canal at the harbor
7. Dredging the canal to maximize exit flow and reduce hydraulic head
8. A second discharge point across Kapiolani Park to the eastern edge of Waikiki Beach

Analysis of these modifications are discussed below. Modifications 5 through 8 are in the early stages and incomplete, although warrant further evaluation in a Validation Study, where value engineering efforts may further advance development or eliminate.

Modeling results reflect floodwalls along the Manoa-Palolo channel and the Makiki diversion culvert.

Consolidating the two pump stations into a single pump station and relocating the pump plant was also evaluated. The consolidation to one pump station and relocating the plant on the northern side of the canal, east of the confluence with the Manoa-Palolo channel would eliminate the requirement of approximately 4,000 linear feet of floodwall on the southern side of the Ala Wai canal. The consolidation of two pump stations into one would also reduce the overall facility footprint, improve efficacy of existing internal stormwater drainage in the Kapahulu area, decrease construction efforts, and reduce long-term maintenance requirements on the Non-Federal Sponsor.

Additionally, realigning the floodwall on the canal in front the Hausten Ditch area was also evaluated. Further consideration of the flood barrier alignment and effort to increase flood water detention, prompted the concept to remove the planned floodwalls along this section of the canal. The walls fronting the canal would be replaced with earthen berms along the sides and back perimeter of Hausten Ditch and the Ala Wai Community Park athletic fields to increase canal reservoir capacity. The flood gate originally proposed at the canal wall would be moved from immediately adjacent to the Ala Wai canal back to the northern perimeter at the back of this detention area spanning Hausten Ditch.

Proposed Modification and Path Forward (Golf course) - The flood barrier system shown in Figure 13 will significantly reduce or eliminate inundation throughout the

lower watershed north and south of the Ala Wai canal, therefore recommend advancing the (1) modified berm alignments around the western half of the golf course, (2) extended floodwalls or berms on the eastern bank of the M-P channel from Date Street to the Ala Wai canal, and (3) expanding the Hausten Ditch detention feature, (4) additional optimization efforts at the base of the Makiki channel, and (5) consolidating the two pump stations into a single station at the confluence of the M-P channel and the Ala Wai canal. Also recommend continued optimization to maximize functionality, enhance environmental benefits, and integrate aesthetics consistent with USACE policy.

Summary

In summary, while the project objective remains the same, the approach has evolved based on more current and accurate data, and hydraulic modeling tools as the plan advanced in the planning, engineering, and design phase. Results of the HEC-RAS 1D/2D unsteady state modeling and accompanying engineering analysis support a shift from flow detention in the upper watersheds to improved conveyance for greater control and risk management throughout the linked system.

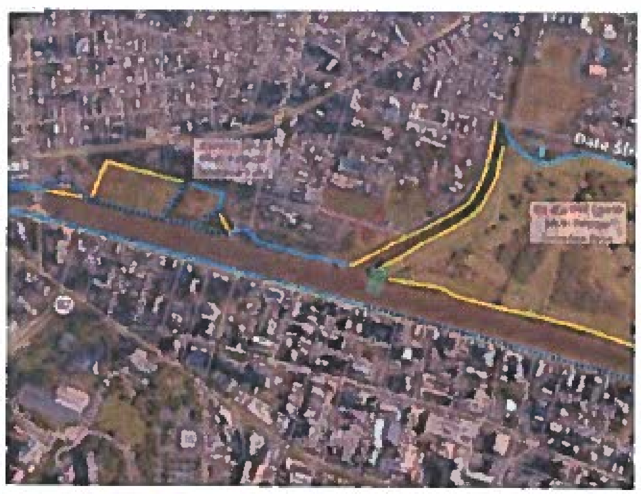

Figure 13 Flood barrier system modifications and alignment in the lower watershed

Figure 14 graphically summarizes the recommended modifications to the flood risk management features planned during the feasibility phase.

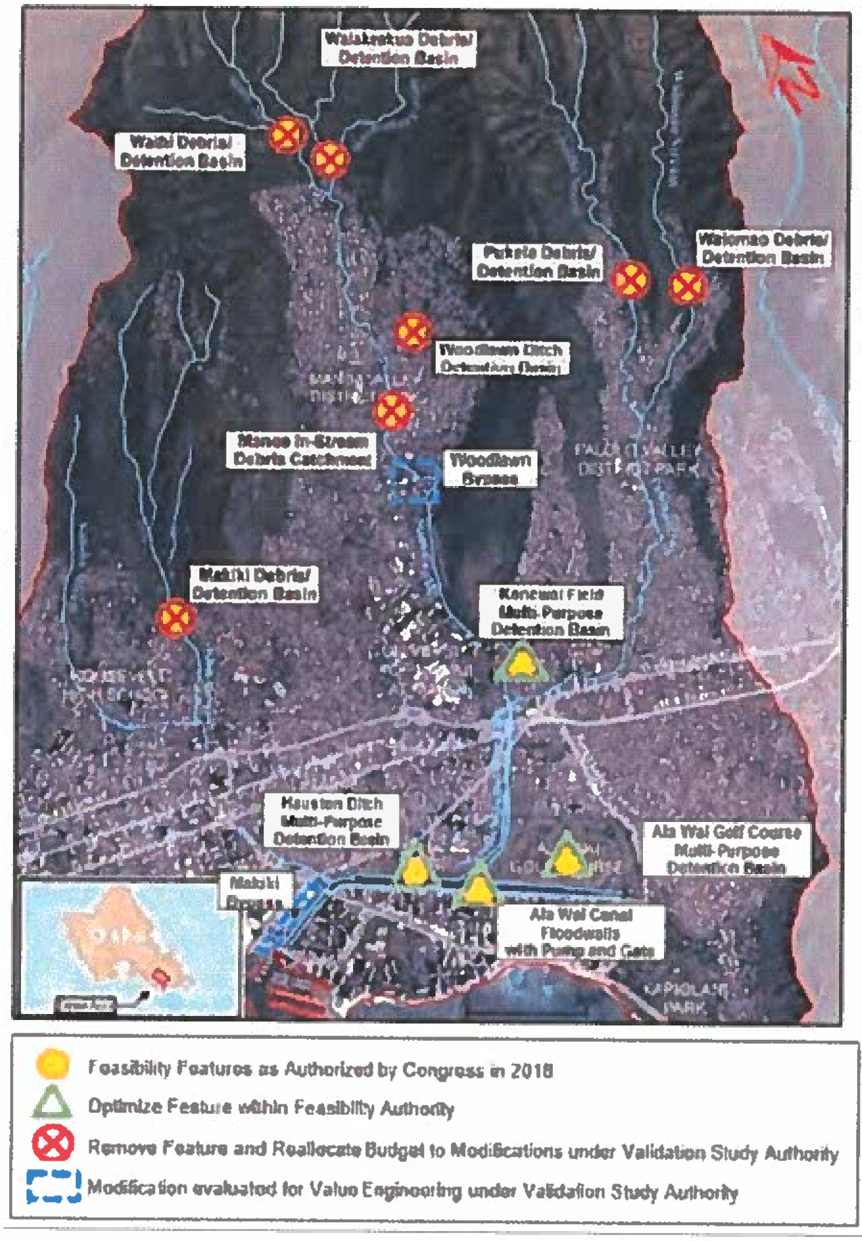

Figure 14 Recommended modifications to the authorized FFEIS Project as detailed in this Engineering Documentation Report

Conclusion

During the pause in the project while USACE was awaiting approval of the Final State EIS, USACE updated its HEC-RAS 1D hydrologic and hydraulic modeling used in preparing its 2017 Feasibility Study to more comprehensive HEC-RAS 1D/2D models to advance the project design.

USACE observed significant differences between the results of the two models. Their findings included: (i) detention basins were insufficient to achieve the benefits modeled in the 2017 Feasibility Study; (ii) increased flow rates from the upper watershed to the middle and lower watershed resulting in more extensive inundation across the base of the watershed; and (iii) the anticipated water surface elevation reductions were not realized due to insufficient detention capacity and flow constraints along the routing.

USACE found that the anticipated reductions in Water Surface Elevations (WSE) expected from the 2017 Feasibility Study could not be achieved with the authorized system features.

In September 2019, the Honolulu District presented its finding to the USACE Vertical Team with a recommendation to investigate modifications to system features necessary for the system to perform as authorized. The Honolulu District was directed to investigate modifications to system features and document recommendations in an Engineering Documentation Report.

Consequently, USACE started evaluating system modifications to the 2017 Feasibility Study risk management features to mitigate these emergent findings. Central to the USACE 2020 modified approach was a shift in concept from temporary storm water detention in the upper watersheds to enhanced conveyance within existing routing throughout the watershed.

The EDR recommends the removal of debris and detention basins in the upper watershed, as well as detention basins at Woodlawn Ditch and a standalone debris catch structure in Manoa Stream. The recommendation includes the addition of a Woodlawn bypass structure and ancillary measures to reduce flood risk at the Manoa Marketplace, University of Hawai'i at Manoa, and the lower watershed communities. The EDR also recommends the addition of a Makiki Stream bypass culvert to reduce risk of backwater flooding from the Ala Wai Canal, as well as reducing flood risk in the lower watershed of the Makiki community. Finally, the EDR recommends modifications to authorized features at Kanewai, Hausten Ditch, Ala Wai Golf Course, and Ala Wai Canal flood barriers with pump stations.

Appendix E: August 19, 2019 Community Meeting Documents

ALA WAI WATERSHED PROJECT COMMUNITY MEETING

WHEN

Monday, August 19, 2019
5:30 p.m.

WHERE

Neal Blaisdell Center
Maui Meeting Room (2nd Floor)
777 Ward Ave, Honolulu, HI 96814
(Free parking available at Center)

COUNCILMEMBERS

- Carol Fukunaga
- Ann Kobayashi
- Tommy Waters

SAVE THE DATE

AGENDA

Opening Remarks & Introductions
Councilmembers Kobayashi, Fukunaga and Waters

PENDING ACTION:

***Resolution 19-182**, Authorizing the Mayor or the Mayor's designee to receive and expend limited purpose monies from the State of Hawaii for the Ala Wai flood risk management project and to convey project property and improvements to the State of Hawaii*

STATUS UPDATE – Next Steps:

***Resolution 19-108**, Amending the Membership of the Permitted Interaction Group established and authorized to investigate Matters Related to the Ala Wai Canal Flood Risk Management Project*

Introduction of Permitted Interaction Group Consultant: Oceanit

ACKNOWLEDGMENTS AND ADJOURNMENT

(Agenda subject to change)

CITY COUNCIL
CITY AND COUNTY OF HONOLULU
530 SOUTH KING STREET, ROOM 202
HONOLULU, HAWAII 96813-3065
TELEPHONE: (808) 768-5010 • FAX: (808) 768-5011

Statement of Councilmembers Ann Kobayashi, Carol Fukunaga
and Tommy Waters
August 19, 2019

Statement Regarding Professional Consultant

The City Council adopted Resolution 19-108 which establishes a Permitted Interaction Group (PIG) to investigate matters relating to the Ala Wai Canal Flood Risk Management Project. The PIG is composed of Councilmember Ann Kobayashi, Carol Fukunaga and Tommy Waters whose districts are directly affected by the plans proposed by the U.S. Army Corp of Engineers.

Through the procurement process, Oceanit has been selected to provide consultant services and draft recommendations to enhance the Army Corp of Engineers' Ala Wai Canal Flood Risk Management Study. Oceanit will report directly to the PIG and its final recommendations will be made available to the public through the City Council.

Oceanit has an extensive resumé in substantive planning, engineering and environmental experience with the Ala Wai Watershed area. They also possess demonstrated experience in integrating native Hawaiian culture and practices and maintaining respect and sensitivity for unique communities.

Because the City faces a very tight timeline, we look forward to immediately employing Oceanit's technical and community outreach skills, their ability to work with all parties, including local, state and federal government legislators and agencies and generate consensus among all stakeholders.

###

Name	Title	Agency/Region
Arnold, Peter	Resident	Palolo
Bagnall, Brian	Resident	Waikiki
Barbour, Brandon	Vice President of Operations	Waikiki Business Improvement District Assoc.
Agustin, Roy	NB #10 member	Makiki
Bolan, Heather	Senator Ihara's Staff	State of Hawaii
Brinker, Amy Kalai		Waikiki
Caldwell, Kirk	Mayor	C&C Honolulu
Char, Nathaniel	NB #10 member	Makiki
Charuk, Andrea (Andi)	Teacher - arts	Seeqs Charter Schools - Palolo
Chun-Lum, Sharlene	Save Ala Moana Beach Park Hui	Ala Moana
Chun, Westley	SSFM	Honolulu
Chung, Franklin		C&C Honolulu
Cloutier, Jonathan		Punchbowl
Cunningham, Chris	Hazard Mitigation & Long-Term Disaster Recovery Program Manager	Office of Climate Change, Sustainability and Resiliency
Davis, Jerry		NOAA
Deemer, Georgette	Dep Managing Director	C&C Honolulu
Dela Cruz, Laurie	5th grade teacher	Hokulani
Farm, Ken	NB #10 Chair	Kalihi Palama
Finley, Robert "Bob"	NB #9 Chair	Waikiki
Fischer, Julius	Project Coordinator	AW Watershed Collaboration - Kaimuki
Freedman, Chuck	Advisor to Senator, US Senate	Kaimuki
Frye, Brad	Retired Boeing Eng	Palolo
Fukumoto, Elton	NB #7 Vice Chair	Manoa
Fukunaga, Carol	Councilmember	City Council, PIG
Gaudlitz, Jay	Senior Project Manager	USACE
Giambelluca, Thomas	Director	UH Water Resources Research Center
Gonzalez, Aurelia	Resident	UHM
Goo, Justin	Program Technical Lead	USACE
Goodyear, Brian	Resident	Kaimuki
Hahn, Dale	Chief of Staff, US Senate	Manoa
Hamnett, Michael	Researcher	UH Social Science Research Institute (SSRI)
Heinrich, Tom and Karen	Sen. Taniguchi Staff	State of Hawaii
Henski, Kathryn	NB #9 Member	Waikiki

Herzog, Jeff	USACE Program Manager	USACE
Hirai, Craig	Director	Department of Budget and Finance
Holmes, Steve	Resident	Palolo
Holmes, Winona (Nona)	Resident	Palolo
Ihara, Les	Senator	State of Hawaii
Kaneshiro, Kenneth PhD	Co-founder and President	Hawaii Exemplary State Foundation
Keahi, Kahealani	Parent	Halau Ku Mana Charter School
Keahi, Pi'imoku	Kalawahine Resident & UHM Student	UHM
Keahi, Punonu	Paddler	Waikiki Yacht Club
Kelly, Kathleen	First Deputy	Corporation Counsel
Kitajima, Ian	PIG Consultant	Oceanit
Kobayashi, Ann	Councilmember	City Council, PIG
Kobayashi, Dale	Representative	State of Hawaii
Koyanagi, Nelson	Director	Dept. of Budget & Fiscal Services
Kroning, Robert	Director	DDC
Lagunero, Jimmy	Emergency Management Coordinator	UHM - Department of Public Safety
Louie, Christine	Resident	Palolo
Lai Young, Susan	NB #10 member	Makiki-Tantalus
Lee-Arnold, Carol	Resident	Palolo
Lee, George	Resident	Palolo
Lee, Grace	Resident	Palolo
Lee. Christopher	Academy for Creative Media	Kaimuki-Kahala
Lum, Bruce	Resident	Ala Moana
Lum, Wendy	Resident	Manoa
Lynch, Sidney	Resident	Protect Our Ala Wai Watersheds - Palolo
Matsumoto, Drew	Resident	Palolo
Molloy, Michael	Resident	Manoa
Moriwaki , Sharon Y	Senator	State of Hawaii
Murai, Daisy	NB #5 member	Moiliili
Nakahara, Fred	NB #10 member	Makiki-Tantalus
Phillipson, Marion	Resident	Makiki
Rauer, Helen	Resident	Makiki
Ross, Ian	NB #10 chair	Makiki-Tantalus
Sasamura, Ross	Director	Director of Facility Maintenance

Say , Calvin K.Y.	Representative	State of Hawaii
Schaefers, Allison	Reporter	Hon Star- Advertiser
Schneider, Niklas	Chair and Professor of Oceanography	UHM - School of Ocean and Earth Science and Technology
Snider, Scott	Resident	Manoa
Sokugawa, Kathy	Director	Department of Permitting and Planning
Stanbro, Josh	Executive Director	Office of Climate Change, Sustainability, and Resilience - Palolo
Sulivan, Pat	Founder & CEO	Oceanit
Tuiala, Levy	PIG Consultant	Oceanit
Turner, Kirsten	Field Rep for Congresswoman Gabbard	US House
Venegas, Hector	Resident	
Watase, Dave	Civil Engineer; Semi-Retired	Stop Ala Wai Project - Palolo
Waters, Tommy	Councilmember	City Council, PIG
Watson, Ellen	NB #7 Member	Manoa
Wilson, Steve	PIG Consultant	Oceanit
Wong, General Darryll	Co-founder	Hawaii Exemplary State Foundation
Wong, Napua	Paradise Park Owner	Manoa
Yee, Sterling	PIG Consultant	Oceanit
Yonamine, Mark	Director	Department of Design and Construction
Yu, Robert	Deputy Director	Department of Budget and Finance

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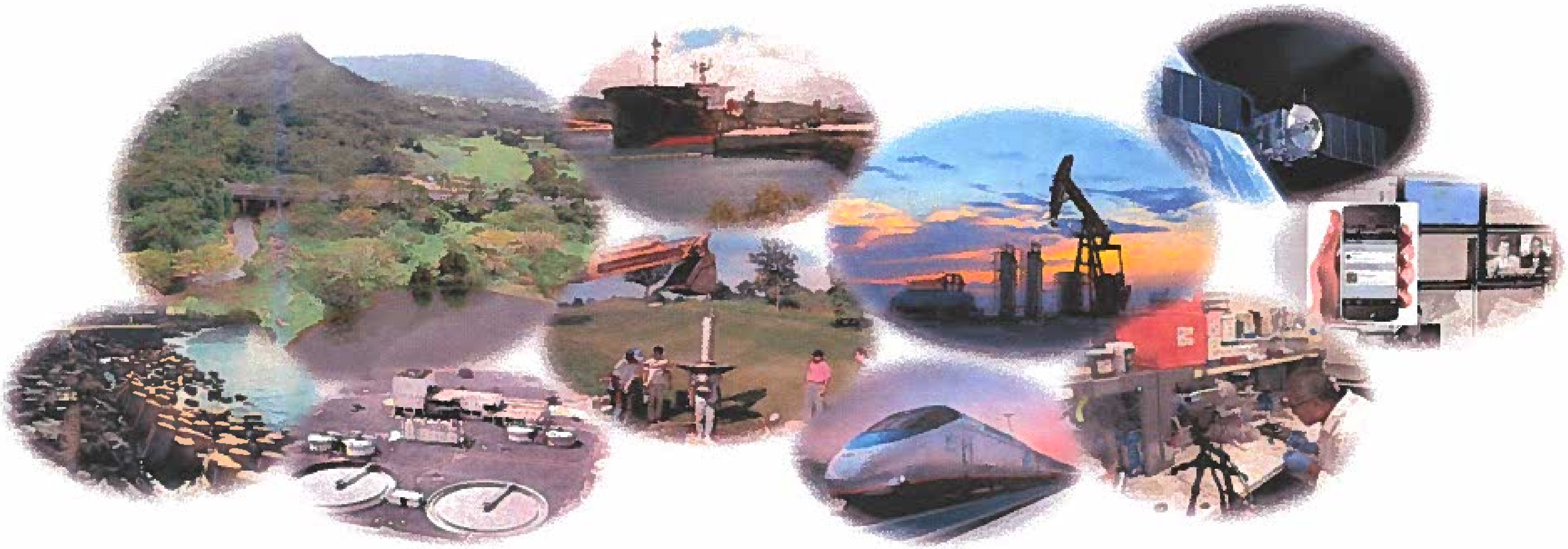

Company Overview

Oceanit

- Founded 1985 in Hawai'i
- 160 Employees
- Multi-Disciplinary Staff (25% PhDs)

Recent Awards

- *2018 **Social Impact Entrepreneurs of the Year**, Hawaii Venture Capital Association*
- *2018 **Intrapreneur of the Year – Ian Kitajima**, Hawaii Venture Capital Association*
- *2016 **Breathe Easy Innovator**, American Lung Association*
- *2016 **CEO of the Year**, Hawaii Business Magazine, Patrick K. Sullivan*
- *2015 **30 Years of Innovation** State (Gov/Mayor) Event*
- *2014 **Oceanit Spin-Out IBIS Networks wins East meets West***
- *2013 **Commitment to Green Employer of the Year**, Pacific Edge*

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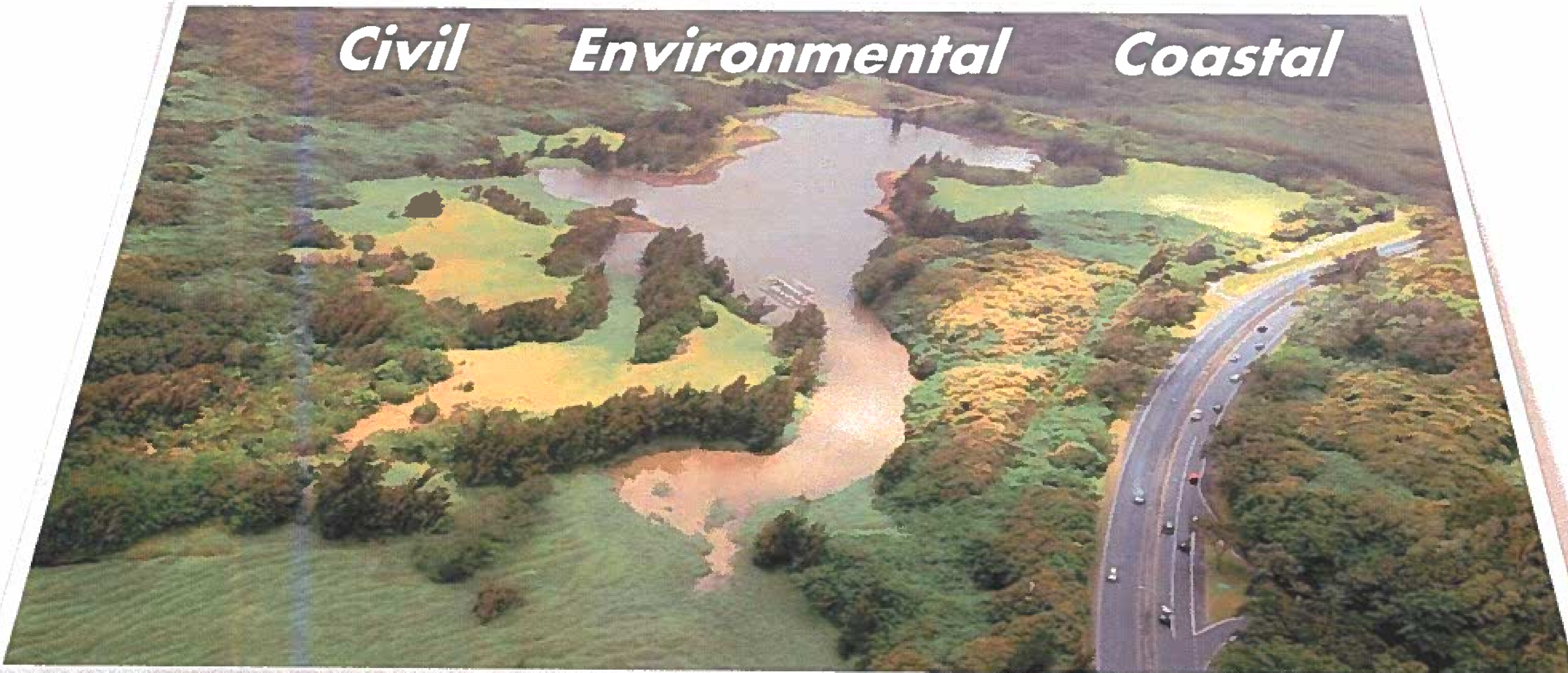
Oceanit's Engineering Innovation

Engineering Services



Science & Technology | Information Systems | Design Thinking

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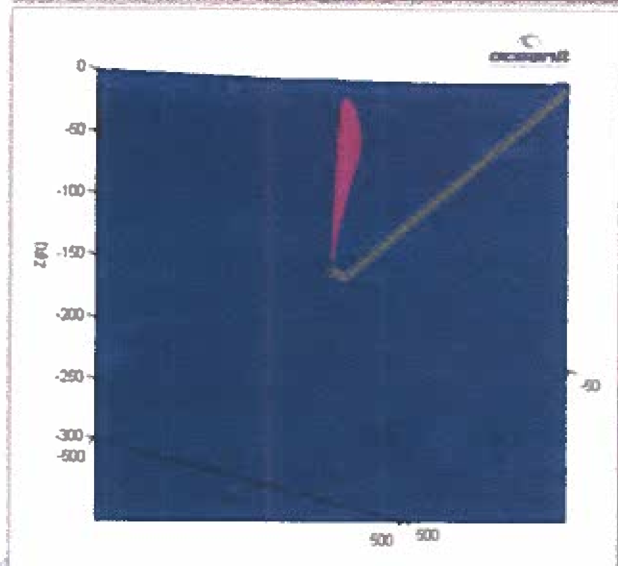
PROPRIETARY

Innovative Solutions



- Flood Damage Reduction
- Infrastructure Analyses
- Compensatory Mitigation
- Outfall Simulations
- Real-Time Data Monitoring

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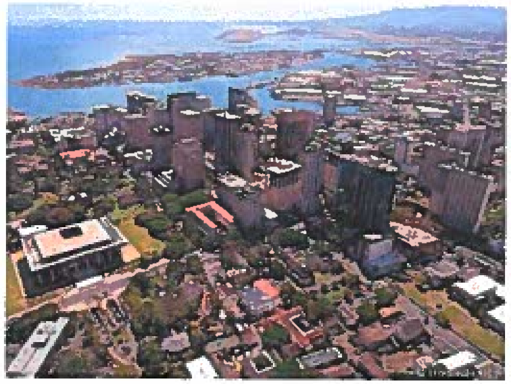
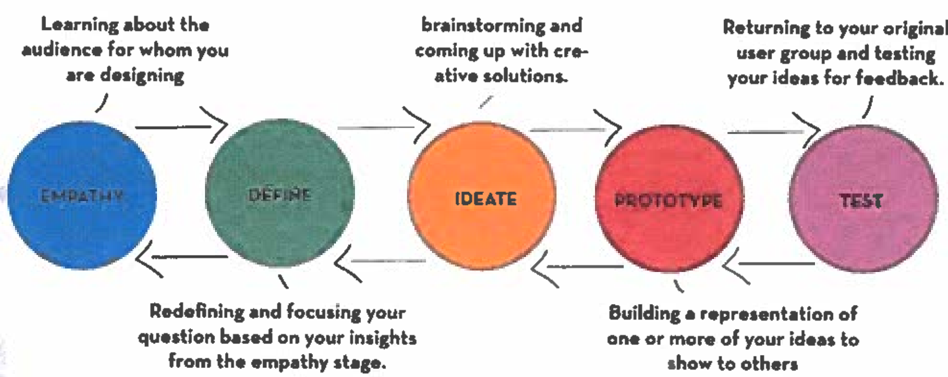
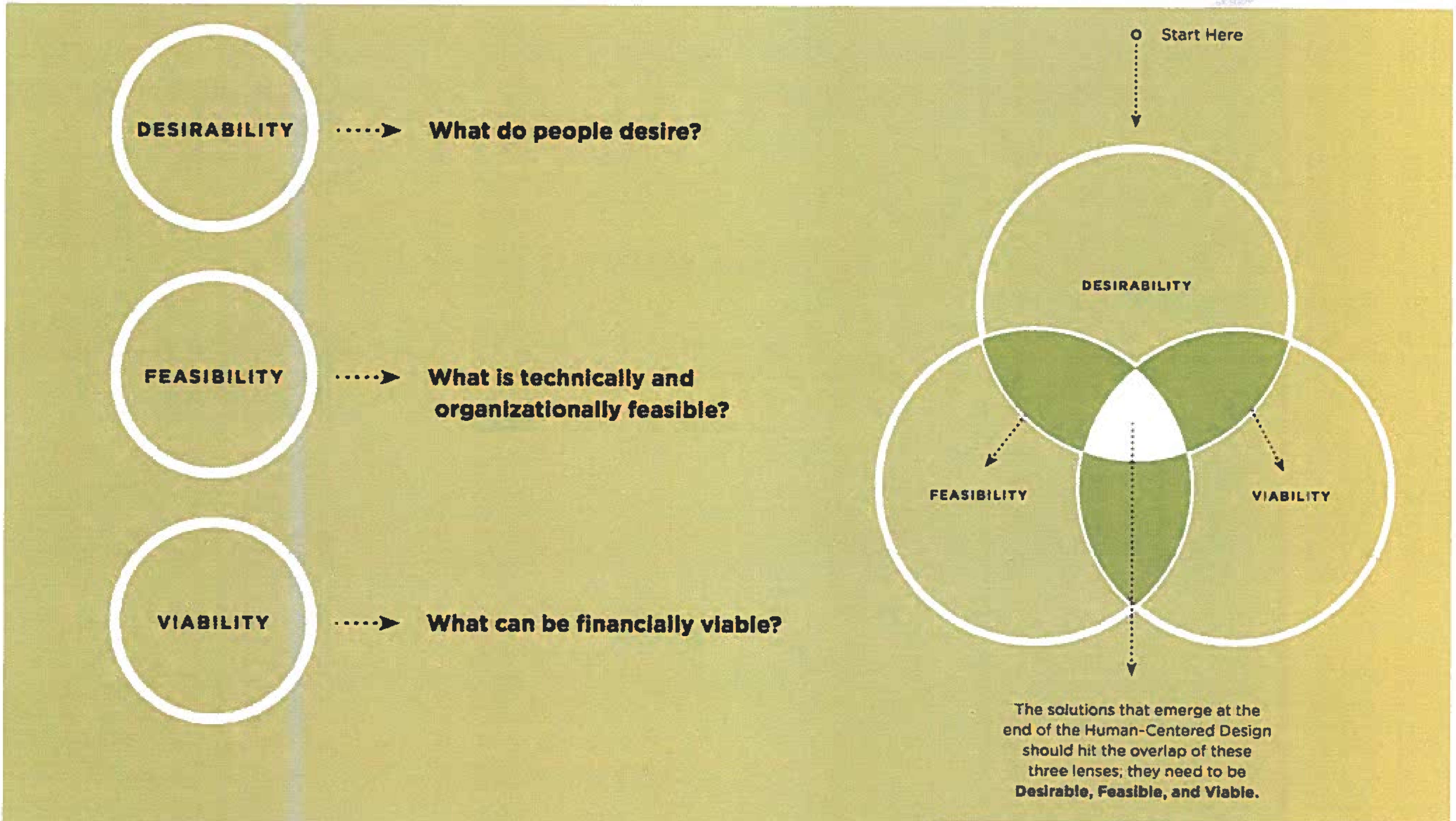


As a local company, Oceanit's approach is tailored to the unique culture and people of Hawaii.

Oceanit has over 15 years of experience in applying Design Thinking methods to identify human centered designs to address and correct issues at their foundation.




DESIRABILITY
What do people desire?
FEASIBILITY
What is technically and organizationally feasible?
VIABILITY
What can be financially viable?
Start Here
DESIRABILITY
FEASIBILITY
VIABILITY
The solutions that emerge at the end of the Human-Centered Design should hit the overlap of these three lenses; they need to be **Desirable, Feasible, and Viable.**

Appendix F: October 1, 2019 Community Meeting Documents

ALA WAI WATERSHED PROJECT COMMUNITY MEETING

WHEN

Tuesday, October 1, 2019
5:30 p.m. to 7:30 p.m.

WHERE

Ala Wai Elementary
Cafeteria
503 Kamoku Street, Honolulu, HI 96826

COUNCILMEMBERS

- Carol Fukunaga
- Ann Kobayashi
- Tommy Waters

SAVE THE DATE

AGENDA

Opening Remarks & Introductions

Councilmembers Fukunaga, Kobayashi, and Waters

PRESENTATION BY OCEANIT:

- Results of Community Outreach
- Results of Alternative Plans Raised by Community

ACKNOWLEDGMENTS AND ADJOURNMENT

(Agenda subject to change)

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Ala Wai Flood Mitigation Community Outreach Report

October 1, 2019

Ala Wai Elementary

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Climate Change Risk Mitigation

High Impact, Low Probability of Extreme Rain Event

Background

- USACE allocation of $220M to address this risk
- Oceanit hired by PIG to conduct community outreach and to solicit alternatives
- Within a two-week period, met with about 100 stakeholders
- Captured detailed input from community stakeholders
- Received interesting alternatives that deserve further research and investigation
- Met with the PIG periodically to provide updates

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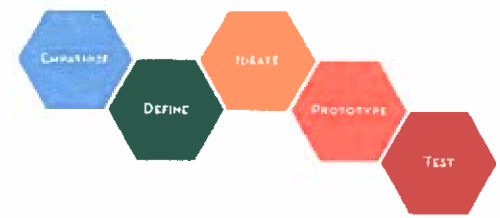
Process

- Met with over 100 people in about 2 weeks
- Used Design Thinking
- Using active listening, identified community input
  - Community concerns
  - Possible alternatives
- Conducted high level conceptual testing of alternatives
- Report results to PIG and the community



Community Outreach Meetings

Community Issues Summary

(what we heard from the community)

- Community is upset - no communication and no transparency
- Plan does not follow NEPA & HEPA (HRS 343)
- Plan does not have community support
- Plan is flawed
- Plan model data is inaccurate or outdated

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Summary of Community Suggestions
(what we heard from the community)

Flood Mitigation
Flood Gates/Locks in the Ala Wai
Flood Pumps in the Ala Wai
Underground Detention Basins
Retractable Canal Walls
Create dryland and wetland plots to help dissipate energy and hold floodwaters
Dredge Ala Wai Canal to improve storage capacity
Ongoing Suggestions...

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Summary of Added Benefits

(what we ***also*** heard from the community)

Ecosystem Restoration
Green Infrastructure
Water Quality Improvement
Stream Maintenance
Repurposed Stormwater
Ahupua'a of Waikiki Recovery

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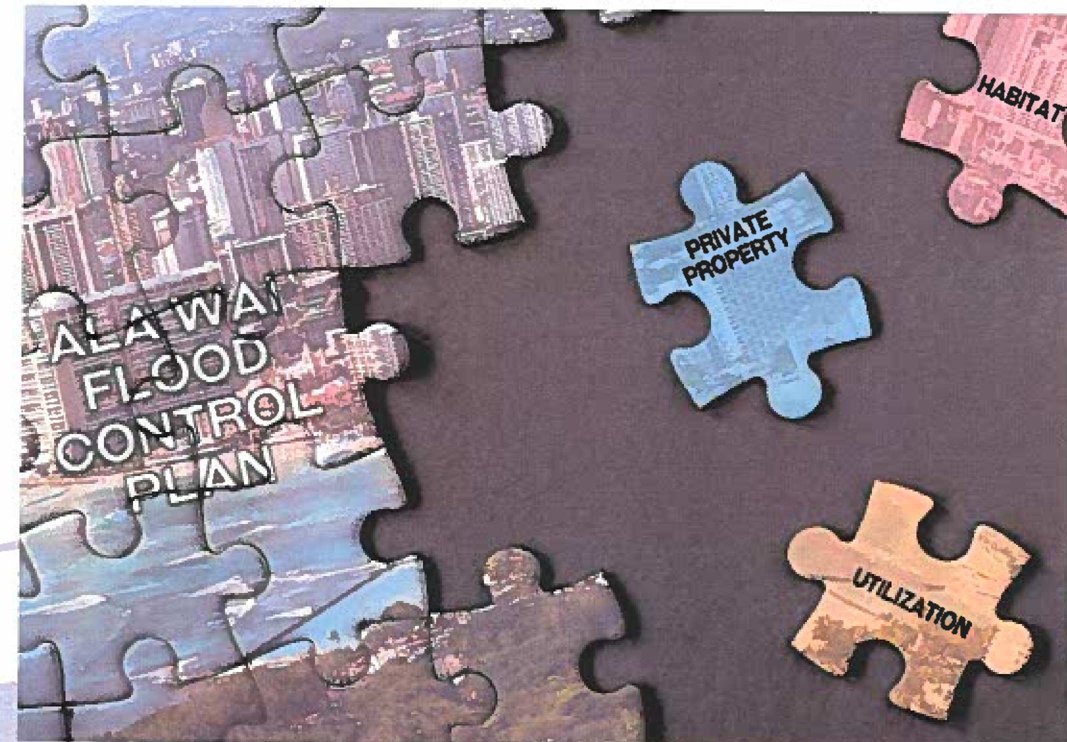
Completing the Picture



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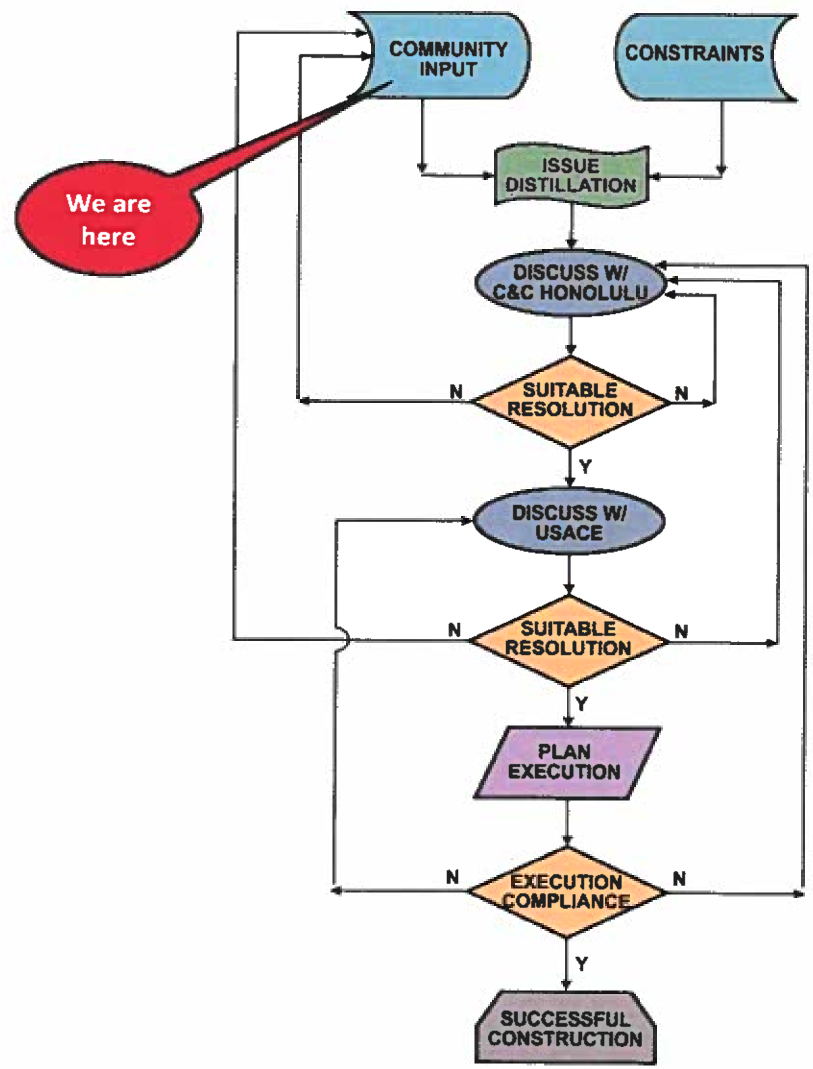
Next Steps



We are here
COMMUNITY INPUT
CONSTRAINTS
ISSUE DISTILLATION
DISCUSS W/ C&C HONOLULU
N
SUITABLE RESOLUTION
N
Y
DISCUSS W/ USACE
N
SUITABLE RESOLUTION
N
Y
PLAN EXECUTION
N
EXECUTION COMPLIANCE
N
Y
SUCCESSFUL CONSTRUCTION

Constituent Sentiment

DISPOSITION	USACE	C&C OF HONOLULU	COMMUNITY
RISK MITIGATION	HIGH	HIGH	HIGH
HABITAT RESTORATION	LOW	MEDIUM	HIGH
PROPERTY RIGHTS	LOW	MEDIUM	HIGH
MAINTENANCE	LOW	HIGH	HIGH
COSTS	HIGH	HIGH	LOW
COMPLIANCE	HIGH	MEDIUM	LOW
UTILIZATION	LOW	MEDIUM	HIGH

HIGH MEDIUM LOW

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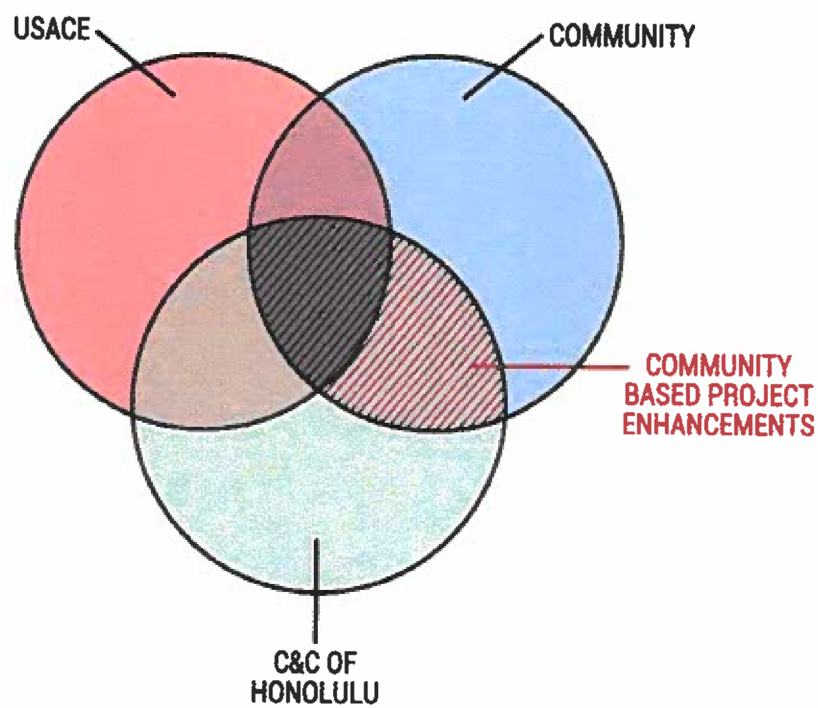
Finding Common Ground



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Questions

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NEWS

HOME / NEWS /

Ala Wai Flood Control Plan - Community Comments

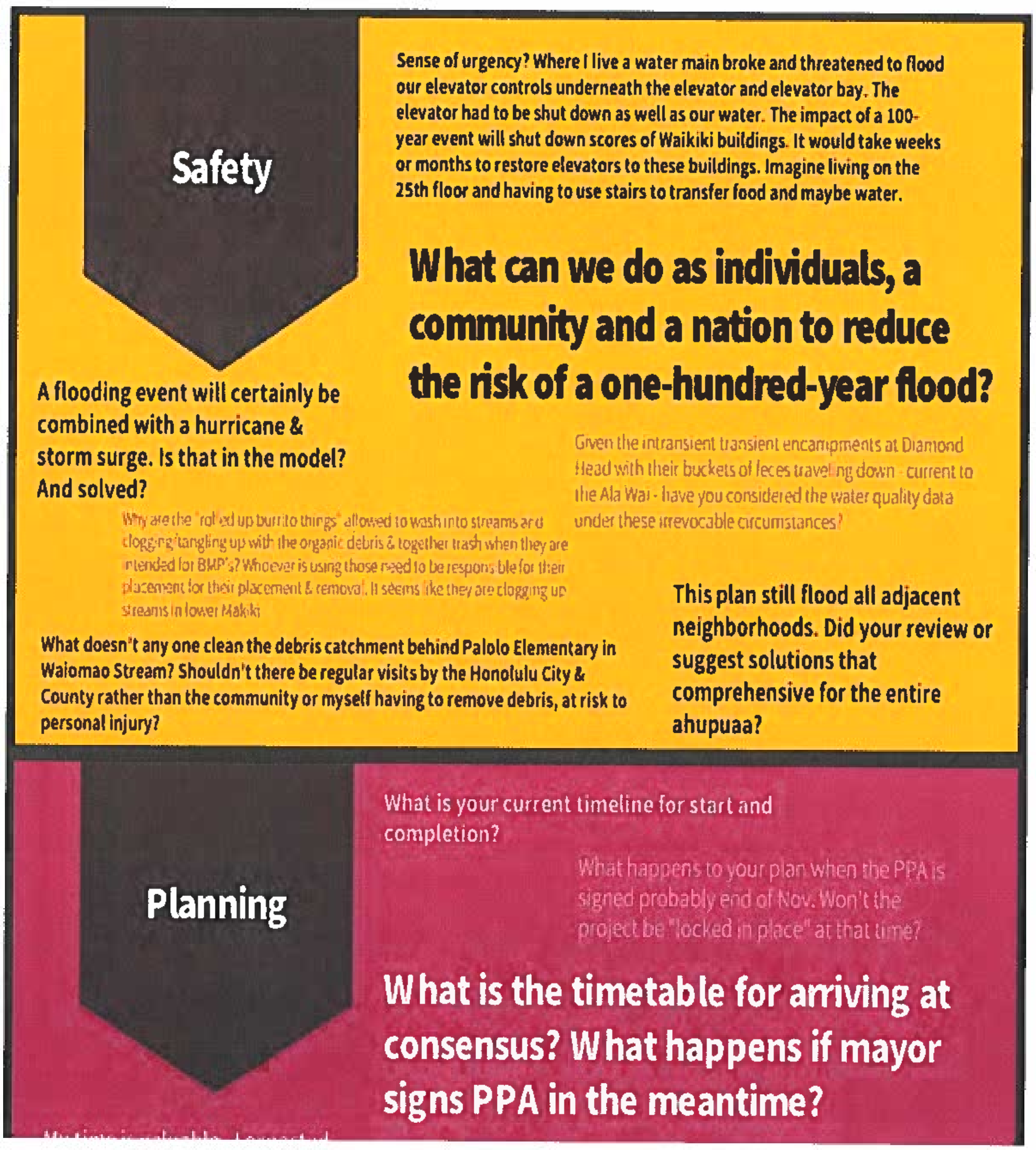
POSTED OCTOBER 17, 2019 IN CIVIL ENGINEERING, DESIGN THINKING, ENVIRONMENTAL ENGINEERING, SUSTAINABILITY

The Ala Wai watershed-Eric Tessmer/Flickr

Oceanit has been working to organize and run community outreach meetings to solicit local engagement on the proposed Ala Wai Canal flood management plans. Oceanit's Innovation Consulting team was contracted by the "Permitted Interaction Group," sanctioned under the City Council and led by Council Members Carol Fukunaga, Ann Kobayashi and Tommy Waters. The primary purpose was to conduct outreach and ideate alternatives to the initial U.S. Army Corps of Engineers watershed plans, which have been met with resistance from local stakeholders who felt left out of the planning process.

Oceanit organized and hosted five community outreach meetings for stakeholders from all levels of the Ala Wai Watershed (Such as Makiki, Manoa and Palolo Valleys, and Waikiki). The result was great input and feedback from many stakeholders affected by the USACE plans. From private homeowners and businesses, to community associations and education groups, over 100 potentially impacted parties joined Oceanit to engage in discussions at community meetings that took place over a multi-week period in September.

In October, Oceanit reported findings to the City Council. The public meeting was held at Ala Wai Elementary School on October 1st at 5:30pm and Oceanit delivered a summary of community inputs and alternatives, and the next steps of this project. These ideas included alternative infrastructures, moveable storm barriers, ecosystem restoration, flood gates and pumps, and retractable walls to control possible flooding. This meeting also allowed participants to provide additional comments and questions. The next phase of work will include a review of the original USACE plan, a review of the recent updates by the Corps, and a review and analysis of alternatives to reach a recommended approach. We are pleased to share the comments and questions provided by meeting participants at the 10/1 Ala Wai Elementary School meeting in this PDF document, and below:



My time is valuable. I expected SPECIFIC PLANS like USACE released this week. Very disappointed this moment.

Didn't the Corp already rule out gates and pumps? Train left the station? Design plan already complete?

Can the scope be adjusted to include water/flood management beyond the stream area? ie. possibility of including flood management strategies in surrounding neighborhoods before rain is in the stream/current scope area?

What is your assurance Army Corps will change the plan given they have said the funding is for the project "as is" and any changes may void the funding?

What is the plan for the Hausten Ditch?

Community Alternatives

Which one of the community suggestions is the most practical?

SERIOUS POLLUTION REDUCTION AND FLOOD MITIGATION when done together lead to different design solutions including constructed wetlands in Ala Wai Golf Course & Kapiolani Park

Which are the viable alternatives?

Why don't we study the way Netherlands/Holland is doing? The top world country underwater (regarding gov technology) - (1) internet research (2) meeting with Dutch engineers (3) twin Dutch city with Honolulu???

What alternatives to detention basins in Manoa mauka would Oceanit recommend?

Will the revised plan with the change in detention basins be approved by HQ? At what time?

To preserve the fragile beauty of our island that is being ruined by taller and danger buildings plus too much concrete, I ask that 4' high concrete walls on Ala Wai are not a part of the solution

Recommend 5 Step Solution:
(1) Focus retention basin at Ala Wai golf course
(2) Dredge Ala Wai to its original 25ft depth
(3) Create feral pig exclusion zone within watershed
(4) Continuous fresh seawater pumping from Kapahulu grain
(5) Instantaneous floodwater pumping and flood gates at Ala Wai bridge

Why not add a flood gate with pumps at Ala Moana Blvd & dredge the Ala Wai canal deeper?

Oceanit Engagement & Communication

What (specific) alternatives to the current Corp. plan is Oceanit researching?

I understand that Oceanit is helping to facilitate dialog and find the sweet-spot compromise. But, mayor and governor & City Council are rushing toward debt financing & a signed PPA without consideration of a dialog or suggestion process

Will Oceanit evaluate or give an opinion on whether the community & affected stakeholders are adequately engaged during the Draft EIS process on the rescoped Ala Wai Project in October 2012?

I'm not a computer person, how do I get in touch with anyone?

Engineering is the first step to a solution. Community ownership & respect for the watershed Mauka & Makai. How can we get government and the community pieces be integral to the puzzle?

Though its the first meeting, not much information given. Alternatives!!

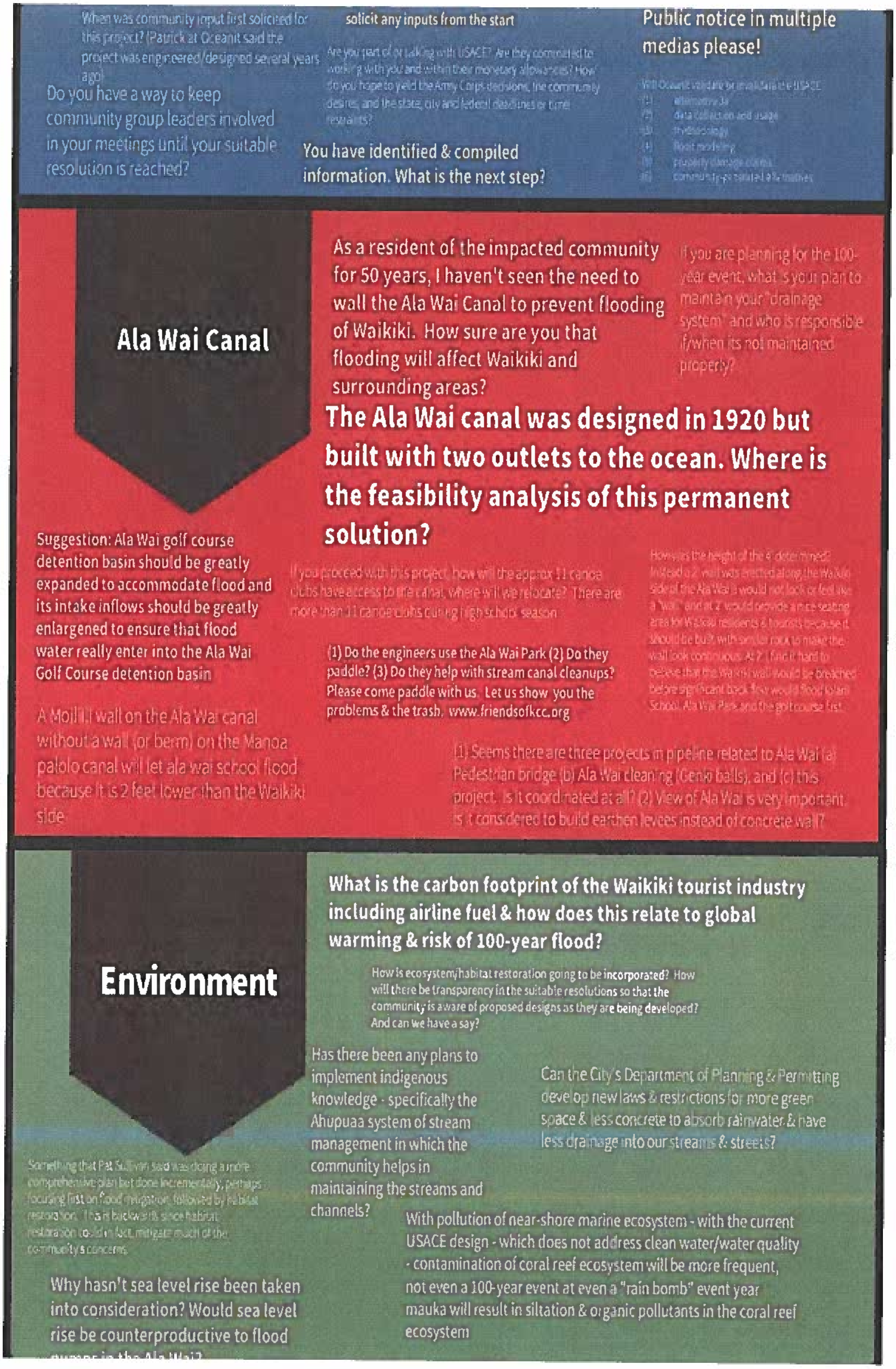
I am a neighborhood board member and it has been very unclear as to how to engage with Oceanit. I would like to be added to the distribution list and invited to future community engagement meetings. Mahalo!

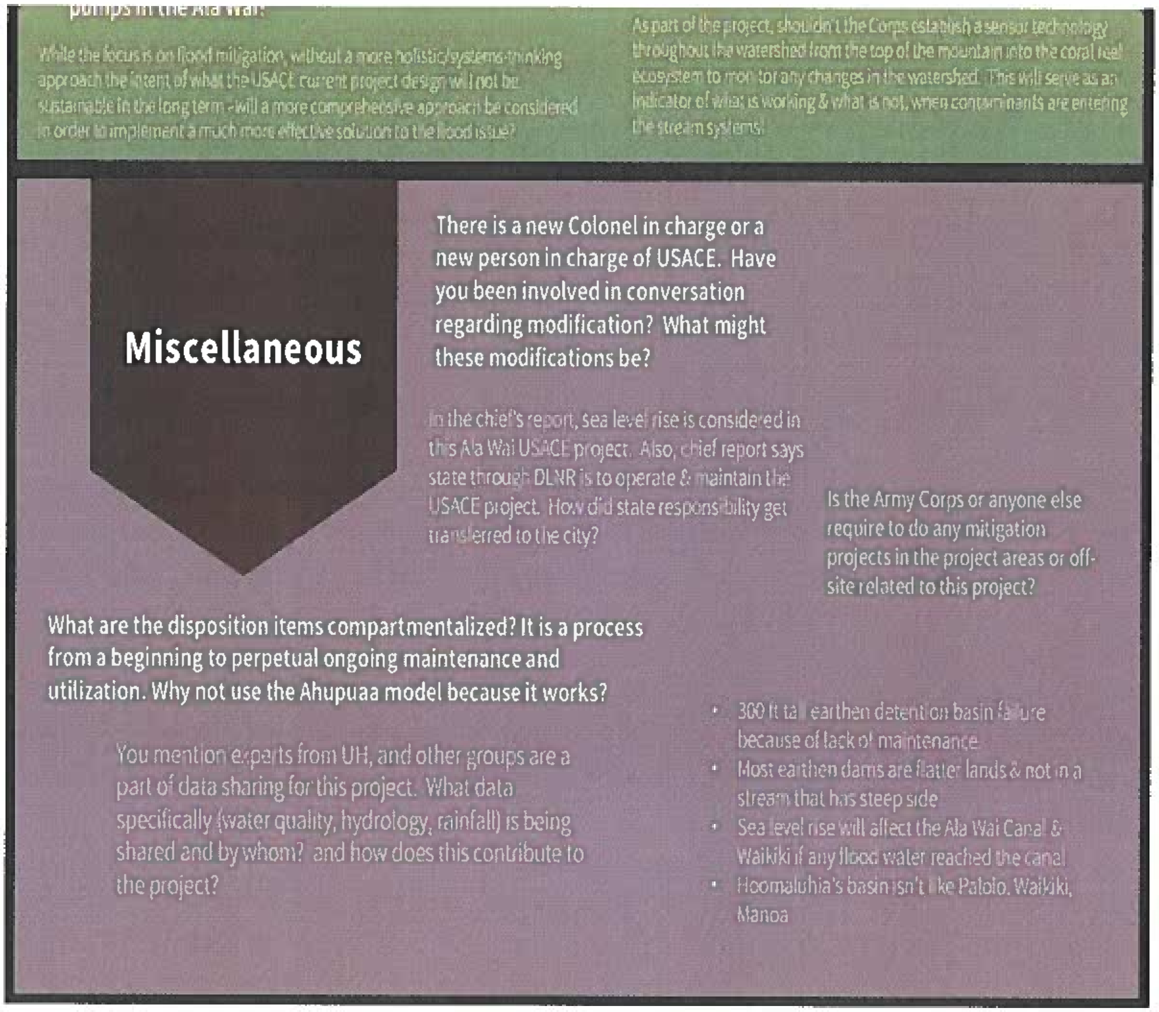
Will this Oceanit process prevent the PPA from being signed?

Does Oceanit have any specific USACE plan changes to recommend?

Why didn't the Corp investigate more fully the user groups? I paddle canoes @McCully and they didn't

When will the next meeting be? Where, when, time?


When was community input first solicited for this project? (Patrick at Oceanit said the project was engineered/designed several years ago)
solicit any inputs from the start
Public notice in multiple medias please!
Do you have a way to keep community group leaders involved in your meetings until your suitable resolution is reached?
Are you part of or talking with USACE? Are they committed to working with you and within their monetary allowances? How do you hope to yield the Army Corps decisions, the community desires, and the state, city and federal deadlines or time restraints?
Will Oceanit validate or invalidate the USACE (1) alternative 3a (2) data collection and usage (3) hydrology (4) flood modeling (5) property damage claims (6) community-generated alternatives
You have identified & compiled information. What is the next step?
Ala Wai Canal
As a resident of the impacted community for 50 years, I haven't seen the need to wall the Ala Wai Canal to prevent flooding of Waikiki. How sure are you that flooding will affect Waikiki and surrounding areas?
If you are planning for the 100-year event, what is your plan to maintain your "drainage system" and who is responsible if/when its not maintained properly?
The Ala Wai canal was designed in 1920 but built with two outlets to the ocean. Where is the feasibility analysis of this permanent solution?
Suggestion: Ala Wai golf course detention basin should be greatly expanded to accommodate flood and its intake inflows should be greatly enlargened to ensure that flood water really enter into the Ala Wai Golf Course detention basin
If you proceed with this project, how will the approx 11 canoe clubs have access to the canal, where will we relocate? There are more than 11 canoe clubs during high school season
(1) Do the engineers use the Ala Wai Park (2) Do they paddle? (3) Do they help with stream canal cleanups? Please come paddle with us. Let us show you the problems & the trash. www.friendsofkcc.org
A Moiliili wall on the Ala Wai canal without a wall (or berm) on the Manoa palolo canal will let ala wai school flood because it is 2 feet lower than the Waikiki side
(1) Seems there are three projects in pipeline related to Ala Wai (a) Pedestrian bridge (b) Ala Wai cleaning (Genki balls), and (c) this project. Is it coordinated at all? (2) View of Ala Wai is very important. Is it considered to build earthen levees instead of concrete wall?
Environment
What is the carbon footprint of the Waikiki tourist industry including airline fuel & how does this relate to global warming & risk of 100-year flood?
How is ecosystem/habitat restoration going to be incorporated? How will there be transparency in the suitable resolutions so that the community is aware of proposed designs as they are being developed? And can we have a say?
Has there been any plans to implement indigenous knowledge - specifically the Ahupuaa system of stream management in which the community helps in maintaining the streams and channels?
Can the City's Department of Planning & Permitting develop new laws & restrictions for more green space & less concrete to absorb rainwater & have less drainage into our streams & streets?
With pollution of near-shore marine ecosystem - with the current USACE design - which does not address clean water/water quality - contamination of coral reef ecosystem will be more frequent, not even a 100-year event at even a "rain bomb" event year mauka will result in siltation & organic pollutants in the coral reef ecosystem
Why hasn't sea level rise been taken into consideration? Would sea level rise be counterproductive to flood



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RESOLUTION 20-229

Introduced: 09/03/20 By: ANN KOBAYASHI Committee: COUNCIL

Title: RESOLUTION ACCEPTANCE OF THE ALA WAI CANAL FLOOD RISK MANAGEMENT PROJECT REPORT OF THE PERMITTED INTERACTION GROUP.

Voting Legend: * = Aye w/Reservations

09/09/20	COUNCIL	RESOLUTION 20-229 WAS ADOPTED. 8 AYES: ANDERSON, ELEFANTE, FUKUNAGA, KOBAYASHI, MANAHAN, MENOR, PINE, WATERS. 1 ABSENT: TSUNEYOSHI.

I hereby certify that the above is a true record of action by the Council of the City and County of Honolulu on this RESOLUTION.

GLEN I. TAKAHASHI, CITY CLERK

IKAIKA ANDERSON, CHAIR AND PRESIDING OFFICER